

CAIS STANDARD MANUAL

SYSTEM NO. 4 BUILDING ROOFING

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ATTN: Ms. Lue Lynch
8725 John J. Kingman Road, Suite 0944
Fort Belvoir, VA 22060-6218

FROM: AL/EQ (STINFO)
139 Barnes Drive, Suite 2
Tyndall AFB FL 32403-5323

SUBJECT: Transmission of Technical Documents

1. As per telephone conversation with Andrew Poulis, EQ/TIC, the attached CAIS CTDS manuals are forwarded for accession, cataloging, and microconversions. Please forward the accession numbers to:

Andrew Poulis
AL/EQ/TIC
139 Barnes Drive, Suite 2
Tyndall AFB, FL 32403-5323

2. The Distribution statement should read as follows: Approved for Public Release: Distribution Unlimited.

3. If you have questions about these documents, please contact Andrew Poulis at DSN 523-6285.


LARRY L. TESTERMAN
Scientific and Technical
Information Program Manager

Atchs: Manuals

04 BUILDING ROOFING

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04 BUILDING ROOFING

ABSTRACT

GENERAL ORGANIZATION

At this installation the list of facilities to be surveyed will be addressed on the basis of 32 unique systems that form the CAIS Engineering Deficiency Standards and Inspection Methods document. Each system deals with a specific technical aspect of the facility to be surveyed. Within each system a further breakdown is made to subsystems, each having a specific list of components. Specific observations of the listed defects are provided so as to allow the entry of observed quantification data. A DOD CAIS manual is provided for each of the 32 systems with an internal organization as outlined below:

INSPECTOR'S GUIDE

- I. General
 - A. Level I Inspection Method Description
 - B. Level II Inspection Method Description
 - C. Level III Inspection Method Description
- II. General Inspection
 - A. Process. This section describes the process of the inspection activity.
 - B. Location. This section describes the procedure for locating the inspection units in the facility or infrastructure on this installation.
- III. Inspector Qualifications

This section notes the minimum qualifications for the person or persons performing the survey.
- IV. Inspection Unit

This section describes how the IU (Inspection Unit) is determined for the particular component being surveyed.
- V. Unit Costs

This section notes the nature of repair costs for this system.
- VI. Standard Safety Requirements

This section lists safety procedures and equipment required to implement a safe environment for the conduct of this survey.
- VII. Standard Tools

This section lists a set of standard tools required for the general conduct of this survey.
- VIII. Special Tools and Equipment Requirements

This section refers to special tools or equipment requirements endemic to the nature of the system being surveyed.

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IX. Level II Inspection Method Keys

This section explains the use of keys as they relate to Level II Guide Sheets.

X. Level III Inspection Method Keys

This section explains the use of keys as they relate to Level III Guide Sheets.

XI. Replacement Cost

This section describes the nature and location of replacement cost data.

XII. Appendices

Appendix A. Provides a listing and definition of all abbreviations used both in the Standards and in the data base.

Appendix B. Provides a glossary of terms with their definitions as used in the Standard.

Appendix C. This section contains a listing of the average life cycle durations for each assembly* in the Standard.

- * Assembly is a term describing the level at which replacement rather than repair occurs. This can be at the subsystem or component designation, depending on the system being surveyed.

SYSTEM TREE

The System Tree is a graphical representation of the Work Breakdown Structure, showing system, subsystem and component relationships for the Building Roofing System.

INSPECTION METHODS

Description

Describes the nature of what is to be condition surveyed.

Special Tool and Equipment Requirements

Lists any special tools required for this specific subsystem.

Special Safety Requirements

This section outlines any special safety measures or equipment required for this specific subsystem so as to maintain a safe environment and process in the conduct of the condition survey.

Component List

All components to be surveyed under this subsystem are listed here.

Related Subsystems

All other subsystems that have a survey relationship to this subsystem are listed here to help coordinate a complete and thorough condition assessment survey.

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Standard Inspection Procedure

This statement indicates the various levels of survey effort required for this subsystem.

Components

The previously listed components of this subsystem are described with a survey procedure recommended on a component by component basis. For each component there is a listing of defects with each defect broken down into observations describing the nature and severity of the defective condition observed. The surveyor enters a quantification value for each defect/observation encountered in the field CAIS device (DCD) to record the result of his survey.

References

This page lists the reference sources from which the foregoing subsystem data was developed.

Guide Sheet Control Number

This section lists the key numbers that tie the written Level II and Level III guide sheets to specific components in this subsystem.

Level II and Level III Inspection Method Guide Sheets

This section contains the detailed descriptions of the Level II and III survey and inspection procedures for this subsystem.

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INSPECTOR'S GUIDE

I. GENERAL

A. Level I Inspection Method

The Level I Inspection Method of building roofing systems consists of a thorough inspection of each subsystem and component as described in the Work Breakdown Structure. The Level I inspection activity is designed to be performed by one inspector; however, a second person may be required to meet standard operating procedures at the installation.

B. Level II Inspection Method

Level II inspections are triggered by defect/observations noted at the Level I inspection or in some cases, are required to conduct a meaningful survey of the component being inspected. The Building Roofing System does not include any Level II inspections. Specialized training and/or excessive inspection time is needed to provide information which is substantially more detailed than that obtained by a Level I inspection. Therefore, further inspections will necessitate a Level III effort.

C. Level III Inspection Method

The Level III inspection is triggered by defect/observations occurring in the Level I and II inspections. The Level III inspection can also occur as a result of time based scheduling, antidotal experience, or component age compared to its life cycle. The Level III inspection is referenced through a Level III key which in turn, denotes a specific Guide Sheet describing the Level III inspection process and requirements. Level III inspections produce a detailed, written engineering assessment of the deficiency along with an estimated cost of correction, and are performed at the option of the Facility Manager.

II. GENERAL INSPECTION

A. Process

Surveys are normally conducted at the component level. Figure 04-A provides the breakdown from system through component for the Building Roofing System. The surveyor will work through the Work Breakdown Structure (WBS) to conduct the inspection. At the component level the surveyor will be provided a list of defects, each of which is described further in detail as observations. These observations are described to various levels of severity as they relate to the effect of the life of the system. The quantification of each deficiency is identified by the surveyor using the associated unit of measure. Once an observation is populated with a deficient quantity, the inspector will be requested to provide information on the component type and location. The installation date or age of the component may be preloaded into the WBS for each asset from the Real Property Inventory List or site specific information.

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If necessary, age data can be overridden by the surveyor, Site CAIS personnel, or the Facility Manager.

B. Location

Level I inspections will be located by the surveyor through a discrete entry in the Field CAIS. Building roof plans or sketches are required to ensure a complete inspection of all areas and to assist in the location of IU's. The inspection team members must use the recommended numbering schemes for the installation. Where numbering systems do not exist or are not complete in identifying each area, specific guidance for the inspector to annotate areas in a consistent manner should be developed by the Facility Manager and implemented in the installations CAS process. In all cases, plans and maps shall be orientated with the top of each sheet being the north direction, so as to allow directional location and description. In the case where no other means of location exist the inspector shall enter a brief (65 character) description of location. Locations must be accurate to insure future repeatability and consistent results.

III. INSPECTOR QUALIFICATIONS

The minimum inspector qualification for the Building Roofing System requires a five year journeyman. All of the condition survey requirements for this system can be accomplished at the Level I inspection by a single inspector, however, safety and other considerations may require that inspectors work in teams. Inspectors will be specifically trained in the CAS system and its usage and will be CAS certified in the "Civil" discipline.

IV. INSPECTION UNIT (IU)

The Inspection Unit (IU) is normally defined at the component level for this system. For many roofing components, a manageable IU would be defined by the section of the roof the component is serving. The following list describes what characteristics roof sections are generally delineated by:

- perimeter details such as firewalls, expansion joints, or area dividers,
- different roof levels,
- areas having different roofing systems,
- areas that were constructed at different times.

Therefore, if a roof section's boundary is defined by a parapet wall on three sides, and an expansion joint on the other one, the IU for the most common components would be defined as follows:

- Roof Covering IU - The total square footage of roof covering within that boundary.

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- Metal Flashing IU - The total linear footage of metal flashing that exists on the perimeter and within that boundary.
- Membrane Flashing IU - The total linear footage of membrane flashing that exists on the perimeter and within that boundary.
- Roof Vent IU, Downspout IU, etc. - Singularly defined items such as these are defined as each.

V. UNIT COSTS

The unit costs that are applied to the quantities recorded for each observation are contained within the Site CAIS as repair cost.

VI. STANDARD SAFETY REQUIREMENTS

The Master Safety Plan will be followed at all times during the condition survey.

Inspector may utilize the following protective gear:

- Hard hat - to be worn during all surveys
- Safety glasses - to be worn during all surveys
- Safety shoes - to be worn during all surveys
- Coveralls - to be worn as necessary
- Gloves - to be worn as necessary
- Ear plugs - to be worn in designated areas
- Knee pads - to be worn when crawling is required
- Rain suit - to be worn as necessary

VII. STANDARD TOOLS

Employee Identification Card - to be worn or carried during all survey activities
Data Collection Device (DCD)
Battery pack for DCD
Flashlight
Tape measure - 12' and 100' (or other supplemental measuring devices)
Screwdrivers - Phillips and straight slot
Pocket knife
Pliers
Binoculars (when required)
Ladder (when required)
Spray paint - to mark defect

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VIII. SPECIAL TOOLS AND EQUIPMENT REQUIREMENTS

At the subsystem level, the deficiency standard has identified special tools and equipment required for the standard inspection of the associated components, which exceed the standard tools identified for the system. Level III Inspection Method Guide Sheets will address additional tools and equipment requirements that are specific to that particular advanced method of inspection.

Facility Managers should review these sections in order to determine any special tool requirements for subsystems they are to inspect/survey.

IX. LEVEL II INSPECTION METHOD KEYS

Certain observations will reference a Level II Inspection Method. The Facility Manager will be able to identify deficiencies where a Level II inspection is flagged. The Level II key at the observation level will refer to a specific guide sheet.

All Level II Guide Sheets are located at the end of each Subsystem section. A Guide Sheet Reference page precedes Level II and Level III Guide Sheets.

X. LEVEL III INSPECTION METHOD KEYS

Certain observations will trigger a Level III inspection. The Facility Manager will be able to identify deficiencies where a Level III inspection is flagged. The Level III Key at the observation level will refer to a specific guide sheet. These guide sheets may refer the Facility Manager to a more sophisticated and costly test method.

All Level III Guide Sheets are located at the end of each Subsystem section. A Guide Sheet Reference page precedes Level II and Level III Guide Sheets.

XI. REPLACEMENT COST

A replacement cost for each subsystem type will be contained within the cost estimating system in the Site CAIS.

XII. APPENDICES

Appendix A - Abbreviations

A summary and definition of all abbreviations used in this system are contained in Appendix A which is located at the end of Building Roofing.

Appendix B - Glossary

A glossary of terms used in this system are contained in Appendix B which is located at the end of Building Roofing.

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Appendix C - Life Cycles

A listing of the average life cycle duration for each assembly* in the Standard.

Note - Facility Manager's Guide

The following are included in the Facility Manager's Guide:

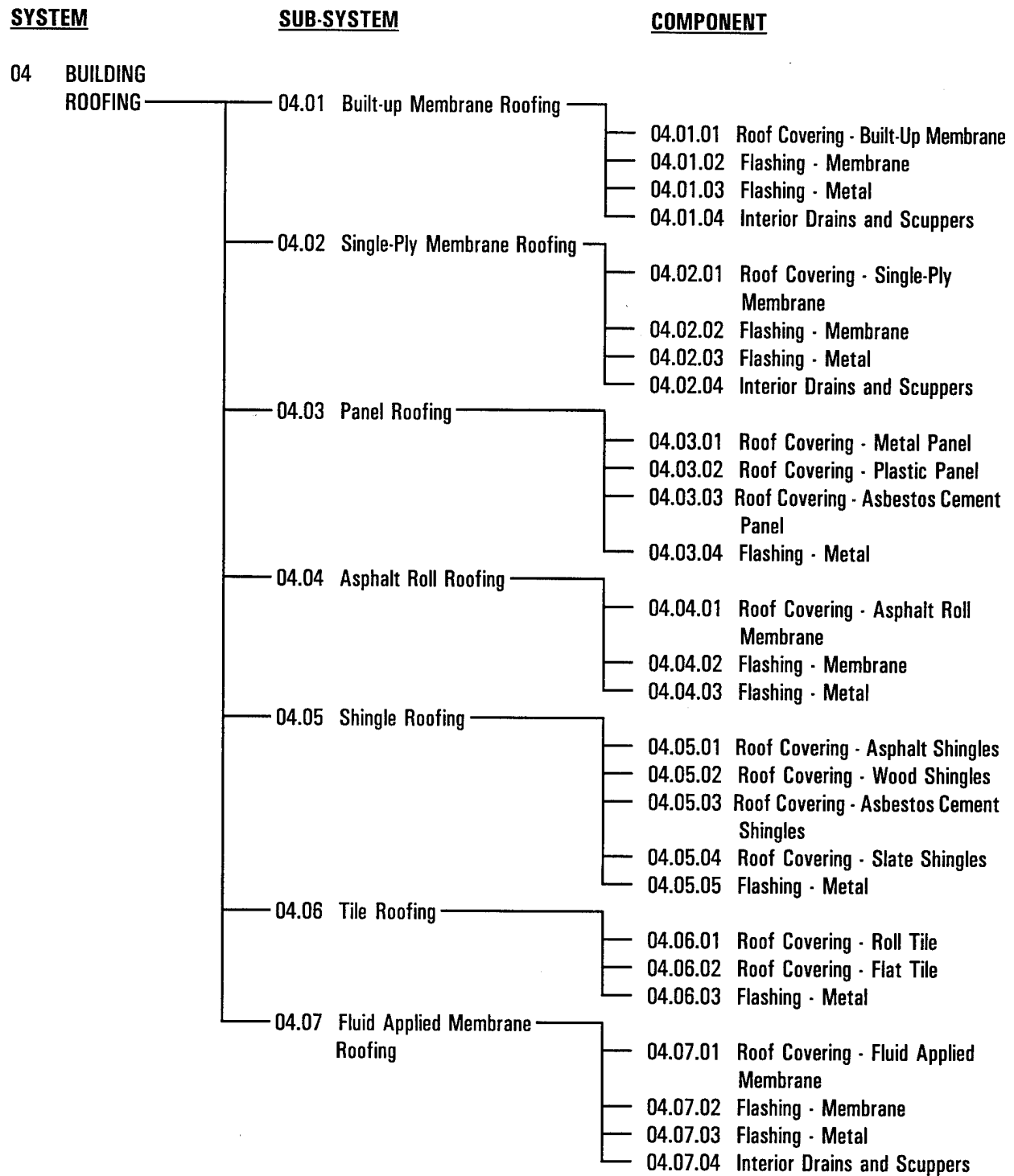
A table showing the required manhours to perform the standard inspection for this facility listed by Cat Code (three digit).

A listing of all Level III inspections with their estimated cost and time to perform. This list will include frequency of inspections for time driven Level III's.

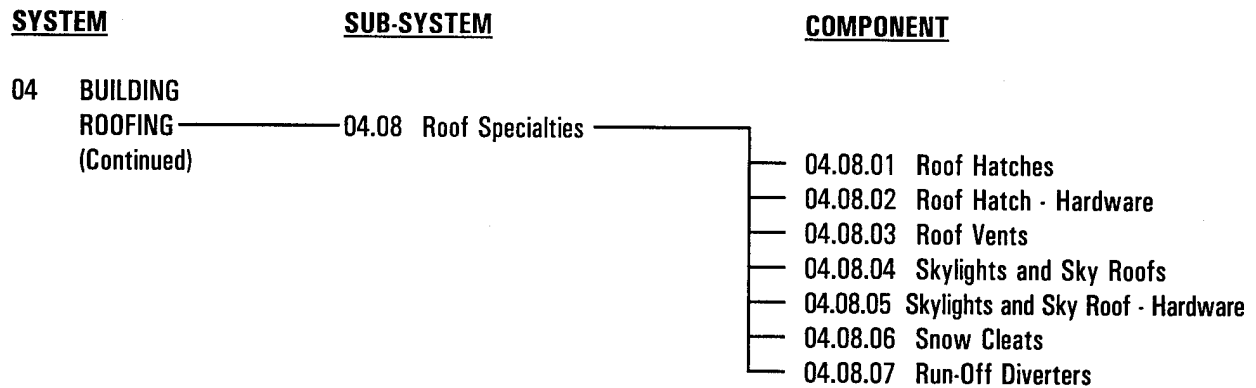
* Assembly is a term describing the level at which replacement rather than repair occurs. This can be at the subsystem or component designation, depending on the system being surveyed.

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Figure 04-A. WORK BREAKDOWN STRUCTURE



04 BUILDING ROOFING

Figure 04-A. WORK BREAKDOWN STRUCTURE (Continued)

04.01 BUILT-UP MEMBRANE ROOFING

DESCRIPTION

Built-Up Membrane Roofing is a subsystem of the Building Roofing System. A built-up membrane roof consists of a continuous roof covering made up of lamination or plies of saturated or coated roofing felts, alternated with layers of asphalt or coal-tar pitch, unsurfaced or surfaced with a layer of gravel, slag or granules. This subsystem also includes the flashing (membrane or metal) required to provide watertight terminations, and the interior drains and scuppers required to shed water from the roof surface.

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

No special tools are needed for the inspection of Built-Up Membrane Roofing, beyond the requirements listed in the Standard Tools Section.

SPECIAL SAFETY REQUIREMENTS

The following special safety requirements, beyond those listed in the Master Safety Plan and System Safety Section, are necessary to perform the inspection of Built-Up Membrane Roofing:

1. Built-up membrane roofs require care when being walked upon to prevent membrane damage.

COMPONENT LIST

- ◆ 04.01.01 ROOF COVERING - BUILT-UP MEMBRANE
- ◆ 04.01.02 FLASHING - MEMBRANE
- ◆ 04.01.03 FLASHING - METAL
- ◆ 04.01.04 INTERIOR DRAINS AND SCUPPERS

RELATED SUBSYSTEMS

Due to the related nature of the elements requiring inspection, the following should be reviewed for concurrent inspection activities. Tree limbs and branches that overhang or contact the roof surface may cause roof damage. These defects and observations should be captured in the Landscaping Subsystem.

04.08	ROOF SPECIALTIES
13.06	LANDSCAPING

04.01 BUILT-UP MEMBRANE ROOFING

STANDARD INSPECTION PROCEDURE

This subsystem requires a Level I inspection as part of the basic inspection process. Associated defects and observations, for each major component, are listed in the inspectors' Data Collection Devices. It may be cost effective at installations with multiple insulated roof systems to obtain an aerial infrared survey of these roofs prior to inspection or after the inspection if numerous Level III's are flagged.

The most common roof defects noted are missing or moved ballast, blisters, weathered felts, splits, cuts, temporary patches, damaged or missing flashing, debris and vegetation, and ponding.

COMPONENTS

◆ 04.01.01 ROOF COVERING - BUILT-UP MEMBRANE

Built-up membrane roofing consists of layers of roofing felts alternating with layers of asphalt or coal-tar pitch, usually ballasted with a layer of gravel, slag or granules.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Blisters.			
Observation:			
a. Blisters with no exposed felts.	SF		
*** {Severity L}			
b. Blisters with exposed felts.	SF		
*** {Severity M}			
c. Broken blisters with exposed underlying plies.	SF		
*** {Severity H}			
* Ridges.			
Observation:			
a. Ridges noticeable, felts are not exposed.	LF		
*** {Severity L}			
b. Surface on ridge is gone, top felt exposed.	LF		
*** {Severity M}			
c. Open breaks in ridge through top ply, exposing underlying plies.	LF		
*** {Severity H}			

04.01 BUILT-UP MEMBRANE ROOFING

COMPONENTS (Continued)

◆ 04.01.01 ROOF COVERING - BUILT-UP MEMBRANE (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Aggregate surface deterioration.			
Observation:			
a. Aggregate not embedded, felts remain covered.	SF		
*** {Severity L}			
b. Open edge laps or fishmouths.	SF		
*** {Severity M}			
c. Aggregate displaced, top coat of bitumen is exposed.	SF		
*** {Severity M}			
d. Aggregate displaced, bitumen pour coat is deteriorated, felts exposed.	SF		
*** {Severity H}			
* Mineral surface-cap deterioration.			
Observation:			
a. Mineral granules missing, exposing the underlying felt.	SF		
*** {Severity L}			
b. Open edge laps or fishmouths.	SF		
*** {Severity M}			
c. Cap sheet felt is deteriorated.	SF		
*** {Severity H}			

04.01 BUILT-UP MEMBRANE ROOFING

COMPONENTS (Continued)

♦ 04.01.01 ROOF COVERING - BUILT-UP MEMBRANE (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Smooth surface-coat deterioration.			
Observation:			
a. Evidence of crazing, hairline cracks (alligatoring).	SF		
*** {Severity L}			
b. Loss of surface coating.	SF		
*** {Severity M}			
c. Open edge laps or fishmouths.	SF		
*** {Severity M}			
d. Alligatoring extends through bitumen to top felt.	SF		
*** {Severity M}			
e. Alligatoring extends through one or more plies.	SF		
*** {Severity H}			
* Patched or repaired areas.			
Observation:			
a. Patching material inferior to or incompatible with existing roof membrane.	SF		
*** {Severity M}			
* Debris on roof.			
Observation:			
a. Foreign objects left on roof, with minor damage potential.	SF		
*** {Severity L}			
b. Foreign objects embedded in roof, major damage imminent.	SF		
*** {Severity M}			
c. Loose debris or trash on roof.	SF		
*** {Severity S}			
* Vegetation on roof.			
Observation:			
a. Evidence of vegetation, not penetrating felts.	SF		
*** {Severity M}			
b. Evidence roots penetrating felts.	SF		
*** {Severity H}			

04.01 BUILT-UP MEMBRANE ROOFING

COMPONENTS (Continued)

◆ 04.01.01 ROOF COVERING - BUILT-UP MEMBRANE (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Grease, solvent, or oil on surface.			
Observation:			
a. Grease, solvent, or oil drippings, no sign of deterioration.	SF		
*** {Severity M}			
b. Grease, solvent, or oil drippings, signs of deterioration.	SF		
*** {Severity H}			
* Substrate failure.			
Observation:			
a. Depressed or soft areas under membrane.	SF		2
*** {Severity H}			
* Improper equipment supports.			
Observation:			
a. Support has displaced membrane, no holes.	SF		
*** {Severity M}			
b. Equipment is bolted through membrane, no apparent leaks.	SF		
*** {Severity M}			
c. Movement of support has punctured membrane.	SF		
*** {Severity H}			
d. Equipment is bolted through membrane, obvious water penetration.	SF		
*** {Severity H}			
* Ponding.			
Observation:			
a. Ponding or evidence of ponding, less than ½ inch in depth.	SF		
*** {Severity M}			
b. Ponding or evidence of ponding, more than ½ inch in depth.	SF		
*** {Severity H}			

04.01 BUILT-UP MEMBRANE ROOFING

COMPONENTS (Continued)

◆ 04.01.01 ROOF COVERING - BUILT-UP MEMBRANE (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Splits, holes and slippage.			
Observation:			
a. Slippage of plys, no obvious water penetration.	SF		
*** {Severity M}			
b. Splits or holes that extend through all membrane felts, obvious water penetration.	SF		1
*** {Severity H}			

04.01 BUILT-UP MEMBRANE ROOFING

COMPONENTS (Continued)

◆ 04.01.02 FLASHING - MEMBRANE

Membrane base flashing is one or more plies of material which extends from the roof surface up onto a vertical or inclined surface providing a watertight termination of the membrane.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Surface defects, splits, holes, or cuts.			
Observation:			
a. Surface coating deterioration allowing membrane to show through.	SF		
*** {Severity L}			
b. Evidence of crazing, hairline cracks (alligatoring).	SF		
*** {Severity L}			
c. Cuts or abrasions, some membrane loss, no obvious water penetration.	SF		
*** {Severity M}			
d. Protruding underlying fasteners or other material.	SF		
*** {Severity M}			
e. Slippage, wrinkling, blistering, or pulling of base flashing material.	SF		
*** {Severity M}			
f. Holes, splits, cuts, or tears, obvious water penetration.	SF		3
*** {Severity H}			
g. Missing flashing.	SF		3
*** {Severity H}			
* Seam defects.			
Observation:			
a. Seam is open less than ½ inch into seam, no obvious water penetration.	LF		
*** {Severity L}			
b. Seam is open more than ½ inch into seam, no obvious water penetration.	LF		
*** {Severity M}			
c. Seam is open, obvious water penetration.	LF		3
*** {Severity H}			

04.01 BUILT-UP MEMBRANE ROOFING

COMPONENTS (Continued)

◆ 04.01.02 FLASHING - MEMBRANE (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Patched or repaired areas.			
Observation:			
a. Patching material inferior to or incompatible with existing roof membrane.	LF		
*** {Severity M}			
* Grease, solvent, or oil on flashing.			
Observation:			
a. Grease, solvent, or oil drippings, no sign of deterioration.	LF		
*** {Severity M}			
b. Grease, solvent, or oil drippings, signs of deterioration.	LF		
*** {Severity H}			
* Exposed gaps and open side laps.			
Observation:			
a. Exposed gaps at top of flashing, no counterflashing.	LF		3
*** {Severity H}			
b. Open side laps, obvious water penetration.	LF		3
*** {Severity H}			
* Flashing height above roof.			
Observation:			
a. Top of base flashing is less than 6 inches above roof surface.	LF		
*** {Severity L}			

04.01 BUILT-UP MEMBRANE ROOFING

COMPONENTS (Continued)

◆ 04.01.03 FLASHING - METAL

Metal flashing may include base flashing, metal cap flashing, counterflashing, embedded edge metal, flashed penetrations, and pitch pans. The metal flashing is used to provide a watertight termination of the membrane.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Damaged or missing metal flashing.			
Observation:			
a. Damaged metal flashing, no obvious water penetration.	LF		
*** {Severity M}			
b. Missing or damaged metal flashing, obvious water penetration.	LF		4
*** {Severity H}			
* Loose metal flashing.			
Observation:			
a. Loose metal flashing, no obvious water penetration.	LF		
*** {Severity M}			
b. Loose metal flashing, obvious water penetration.	LF		4
*** {Severity H}			
* Corrosion.			
Observation:			
a. Surface protective coating missing (paint/galvanizing).	LF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	LF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	LF		
*** {Severity H}			

04.01 BUILT-UP MEMBRANE ROOFING

COMPONENTS (Continued)

◆ 04.01.03 FLASHING - METAL (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Missing flashing sealant.			
Observation:			
a. Missing flashing sealant, no obvious water penetration.	LF		
*** {Severity M}			
b. Missing flashing sealant, obvious water penetration.	LF		4
*** {Severity H}			
* Joint cover defects.			
Observation:			
a. Damaged joint covers, no obvious water penetration.	LF		
*** {Severity M}			
b. Missing or damaged joint covers, obvious water penetration.	LF		4
*** {Severity H}			
* Patched or repaired areas.			
Observation:			
a. Patching material inferior to or incompatible with existing flashing.	LF		
*** {Severity M}			

04.01 BUILT-UP MEMBRANE ROOFING

COMPONENTS (Continued)

◆ 04.01.03 FLASHING - METAL (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Flashed penetration defects.			
Observation:			
a. Damaged flashing sleeve, no obvious water penetration.	EA		
*** {Severity M}			
b. Pitch pan sealer is below metal rim, allowing ponding in the pan.	SF		
*** {Severity M}			
c. Missing or damaged flashing sleeve, obvious water penetration.	EA		4
*** {Severity H}			
d. Pitch pan sealer is cracked or separated from the pan or penetration.	SF		
*** {Severity H}			
e. Pitch pan perimeter metal damaged or missing.	LF		
*** {Severity H}			
* Exposed fastener defects.			
Observation:			
a. Grommet or sealant missing on exposed fasteners.	EA		
*** {Severity M}			
* Base flashing height above roof.			
Observation:			
a. Top of base flashing less than 6 inches above roof surface.	LF		
*** {Severity L}			

04.01 BUILT-UP MEMBRANE ROOFING

COMPONENTS (Continued)

◆ 04.01.04 INTERIOR DRAINS AND SCUPPERS

An interior drain is a penetration of the roof membrane that allows water to flow into a piped drainage system. A scupper is a channel through a parapet or raised roof edge that is designed to drain the roof.

Note: 1. Clogged interior roof drain pipe should be addressed under 07.04 Storm Water Collection Systems. Only the strainer, bowl and clamping ring will be covered in this section.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Scupper metal deterioration or damage.			
Observation:			
a. Missing downspout straps.	EA		
*** {Severity L}			
b. Scupper shows loss of protective coating or metal corrosion.	SF		
*** {Severity M}			
c. Scupper gravel stop damaged or missing.	EA		
*** {Severity M}			
d. Scupper metal has holes present.	SF		
*** {Severity H}			
e. Collector damaged or missing.	EA		
*** {Severity H}			
f. Downspout damaged or missing.	EA		
*** {Severity H}			
* Strainer, bowl and clamp defects.			
Observation:			
a. Strainer is broken or missing.	EA		
*** {Severity M}			
b. Clamping ring loose or missing.	EA		
*** {Severity H}			
c. Drain bowl loose from roof deck or drain pipe.	EA		
*** {Severity H}			

04.01 BUILT-UP MEMBRANE ROOFING

REFERENCES

1. USACERL Technical Report M-87/13, Volume II, September 1987, "Membrane and Flashing Condition Indexes for Built-Up Membrane Roofs - Inspection and Distress Manual".
2. Means Building Construction Cost Data, R.S. Means Company Inc., 1993
3. Roof Surveys and Inspections, Roofing Industry Educational Institute

04.01 BUILT-UP MEMBRANE ROOFING

LEVEL II KEY GUIDE SHEET CONTROL NUMBER

N/A

LEVEL III KEY GUIDE SHEET CONTROL NUMBER

1	GS-III 04.01.01-1
2	GS-III 04.01.01-2
3	GS-III 04.01.02-3
4	GS-III 04.01.03-4

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1

COMPONENT: ROOF COVERING - BUILT-UP MEMBRANE
CONTROL NUMBER: GS-III 04.01.01-1

Application

This guide applies to the investigation into the extent of water intrusion under a built-up membrane roof covering by one of three methods: nuclear, electrical capacitance or infrared thermography. Do not initiate this effort if the roofing system is covered under a current contract or warranty.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Be alert to where you walk and never back up without looking first.
2. Be especially cautious on windy days and when ice and snow are present.

Inspection Actions

1. Perform selected test to determine extent of suspected water intrusion under roof membrane.
2. Investigate surrounding area and areas beneath the roof for equipment, piping, etc. that may affect the moisture detection device responses, i.e. uninsulated steam or hot water lines below the roof surface will seriously affect infrared thermography.
3. If water intrusion is still evident, take core samples and place in sealable plastic bags for later analysis as to the moisture concentration.
4. Record location/boundaries of affected roof areas(s).
5. Patch/repair all cored areas immediately according to the membrane manufacturer's recommendations/specifications.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

- | | |
|---------------------------|---------------------------|
| 1. Nuclear Moisture Meter | 6. Heat welding equipment |
| 2. Knife | 7. Brush |
| 3. Patching material | 8. Infrared camera |
| 4. Adhesive | 9. Capacitance meter |
| 5. Sealant | |

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1 (Continued)

COMPONENT: ROOF COVERING - BUILT-UP MEMBRANE
CONTROL NUMBER: GS-III 04.01.01-1

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Roof Moisture Detection Methods, Building Design and Construction, October, 1983

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2

COMPONENT: ROOF COVERING - BUILT-UP MEMBRANE
CONTROL NUMBER: GS-III 04.01.01-2

Application

This guide applies to the investigation of depressed or soft areas under the membrane surface, by one of three methods: nuclear, electrical capacitance or infrared thermography. Do not initiate this effort if the roofing system is covered under a current contract or warranty.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Be alert to where you walk and never back up without looking first.
2. Be especially cautious on windy days and when ice and snow are present.

Inspection Actions

1. Perform selected test to determine extent of suspected water intrusion under roof membrane.
2. Investigate surrounding area and areas beneath the roof for equipment, piping, etc. that may affect the moisture detection device responses, i.e. uninsulated steam or hot water lines below the roof surface will seriously affect infrared thermography.
3. If water intrusion is still evident, take core samples and place in sealable plastic bags for later analysis as to the moisture concentration.
4. Record location/boundaries of affected roof areas(s).
5. Patch/repair all cored areas immediately according to the membrane manufacturer's recommendations/specifications.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

- | | |
|---------------------------|---------------------------|
| 1. Nuclear Moisture Meter | 6. Heat welding equipment |
| 2. Knife | 7. Brush |
| 3. Patching material | 8. Infrared camera |
| 4. Adhesive | 9. Capacitance meter |
| 5. Sealant | |

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2 (Continued)

COMPONENT: ROOF COVERING - BUILT-UP MEMBRANE
CONTROL NUMBER: GS-III 04.01.01-2

References

1. Roof Moisture Detection Methods, Building Design and Construction, October, 1983

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3

COMPONENT: FLASHING - MEMBRANE
CONTROL NUMBER: GS-III 04.01.02-3

Application

This guide applies to the investigation into the extent of water intrusion under membrane flashing, by one of three methods: nuclear, electrical capacitance or infrared thermography. Do not initiate this effort if the roofing system is covered under a current contract or warranty.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Be alert to where you walk and never back up without looking first.
2. Be especially cautious on windy days and when ice and snow are present.

Inspection Actions

1. Perform selected test to determine extent of suspected water intrusion under roof membrane.
2. Investigate surrounding area and areas beneath the roof for equipment, piping, etc. that may affect the moisture detection device responses, i.e. uninsulated steam or hot water lines below the roof surface will seriously affect infrared thermography.
3. If water intrusion is still evident, take core samples and place in sealable plastic bags for later analysis as to the moisture concentration.
4. Record location/boundaries of affected roof areas(s).
5. Patch/repair all cored areas immediately according to the membrane manufacturer's recommendations/specifications.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

- | | |
|---------------------------|---------------------------|
| 1. Nuclear Moisture Meter | 6. Heat welding equipment |
| 2. Knife | 7. Brush |
| 3. Patching material | 8. Infrared camera |
| 4. Adhesive | 9. Capacitance meter |
| 5. Sealant | |

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors

LEVEL III INSPECTION METHOD GUIDE SHEET

such as problematic conditions.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3 (Continued)

COMPONENT: ROOF COVERING - BUILT-UP MEMBRANE
CONTROL NUMBER: GS-III 04.01.02-3

References

1. Roof Moisture Detection Methods, Building Design and Construction, October, 1983

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4

COMPONENT: FLASHING - METAL
CONTROL NUMBER: GS-III 04.01.03-4

Application

This guide applies to the investigation into the extent of water intrusion under metal flashing, by one of three methods: nuclear, electrical capacitance or infrared thermography. Do not initiate this effort if the roofing system is covered under a current contract or warranty.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Be alert to where you walk and never back up without looking first.
2. Be especially cautious on windy days and when ice and snow are present.

Inspection Actions

1. Perform selected test to determine extent of suspected water intrusion under roof membrane.
2. Investigate surrounding area and areas beneath the roof for equipment, piping, etc. that may affect the moisture detection device responses, i.e. uninsulated steam or hot water lines below the roof surface will seriously affect infrared thermography.
3. If water intrusion is still evident, take core samples and place in sealable plastic bags for later analysis as to the moisture concentration.
4. Record location/boundaries of affected roof areas(s).
5. Patch/repair all cored areas immediately according to the membrane manufacturer's recommendations/specifications.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

- | | |
|---------------------------|---------------------------|
| 1. Nuclear Moisture Meter | 6. Heat welding equipment |
| 2. Knife | 7. Brush |
| 3. Patching material | 8. Infrared camera |
| 4. Adhesive | 9. Capacitance meter |
| 5. Sealant | |

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4 (Continued)

COMPONENT: ROOF COVERING - BUILT-UP MEMBRANE
CONTROL NUMBER: GS-III 04.01.03-4

References

1. Roof Moisture Detection Methods, Building Design and Construction, October, 1983

04.02 SINGLE-PLY MEMBRANE ROOFING

DESCRIPTION

Single-Ply Membrane Roofing is a subsystem of the Building Roofing System. Single-ply membrane roofs have a single isotropic layer, equal strength in both directions, and are more resistant to moisture and sub-zero temperatures than built-up roofing membranes. This subsystem also includes the flashing (membrane and metal) required to provide watertight terminations, and the interior drains and scuppers required to shed water from the roof surface.

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

No special tools are needed for the inspection of Single-Ply Membrane Roofing, beyond the requirements listed in the Standard Tools Section.

SPECIAL SAFETY REQUIREMENTS

The following special safety requirements, beyond those listed in the Master Safety Plan and System Safety Section, are necessary to perform the inspection of Single-Ply Membrane Roofing:

1. Single-ply membrane roofs require care when being walked upon to prevent membrane damage.

COMPONENT LIST

- ◆ 04.02.01 ROOF COVERING - SINGLE-PLY MEMBRANE
- ◆ 04.02.02 FLASHING - MEMBRANE
- ◆ 04.02.03 FLASHING - METAL
- ◆ 04.02.04 INTERIOR DRAINS AND SCUPPERS

RELATED SUBSYSTEMS

Due to the related nature of the elements requiring inspection, the following should be reviewed for concurrent inspection activities. Tree limbs and branches that overhang or contact the roof surface may cause roof damage. These defects and observations should be captured in the Landscaping Subsystem.

04.08	ROOF SPECIALTIES
13.06	LANDSCAPING

04.02 SINGLE-PLY MEMBRANE ROOFING

STANDARD INSPECTION PROCEDURE

This subsystem requires a Level I inspection as part of the basic inspection process. Associated defects and observations, for each major component, are listed in the inspectors' Data Collection Devices. It may be cost effective at installations with multiple insulated roof systems to obtain an aerial infrared survey of these roofs prior to inspection or after the inspection if numerous Level III's are flagged.

The most common roof defects noted are cuts, punctures, open seams, missing lap sealant, protruding screws, debris under covering, improper patching, debris on roof, shifted ballast and ponding.

COMPONENTS

◆ 04.02.01 ROOF COVERING - SINGLE-PLY MEMBRANE

A single-ply membrane roof is a single layer, ballasted, providing a watertight covering for the surface.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Surface defects, splits, holes, or cuts.			
Observation:			
a. Surface coating deterioration allowing membrane to show through.	SF		
*** {Severity L}			
b. Splits, cuts, or abrasions, some membrane loss, no obvious water penetration.	SF		
*** {Severity M}			
c. Protruding/loose underlying fasteners or other material.	SF		
*** {Severity H}			
d. Holes, splits, cuts, or tears, obvious water penetration.	SF		1
*** {Severity H}			

04.02 SINGLE-PLY MEMBRANE ROOFING

COMPONENTS (Continued)

◆ 04.02.01 ROOF COVERING - SINGLE-PLY MEMBRANE (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Seam defects.			
Observation:			
a. Missing lap edge sealant.	LF		
*** {Severity L}			
b. Seam is open less than ½ inch into seam, no obvious water penetration.	LF		
*** {Severity L}			
c. Seam is open more than ½ inch into seam, no obvious water penetration.	LF		
*** {Severity M}			
d. Seam is open, obvious water penetration.	LF		1
*** {Severity H}			
* Substrate failure.			
Observation:			
a. Depressed or soft areas under membrane.	SF		2
*** {Severity H}			
* Membrane deformation.			
Observation:			
a. Membrane deformation, bridging over misaligned substrate, less than 2" deflection.	SF		
*** {Severity L}			
b. Membrane deformation, bridging over misaligned substrate, greater than 2" deflection.	SF		
*** {Severity M}			
c. Membrane stretched, delaminated from substrate, by negative pressure lifting.	SF		
*** {Severity H}			
* Patched or repaired areas.			
Observation:			
a. Patching material inferior to or incompatible with existing roof membrane.	SF		
*** {Severity M}			

04.02 SINGLE-PLY MEMBRANE ROOFING

COMPONENTS (Continued)

◆ 04.02.01 ROOF COVERING - SINGLE-PLY MEMBRANE (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Grease, solvent, or oil on surface.			
Observation:			
a. Grease, solvent, or oil drippings, no sign of deterioration.	SF		
*** {Severity M}			
b. Grease, solvent, or oil drippings, signs of deterioration.	SF		
*** {Severity H}			
* Ballast defects.			
Observation:			
a. Stone ballast thin/missing from surface.	SF		
*** {Severity M}			
b. Broken or missing cast masonry unit ballast.	SF		
*** {Severity M}			
* Debris on roof.			
Observation:			
a. Foreign objects left on roof, with minor damage potential.	SF		
*** {Severity L}			
b. Foreign objects left on roof, embedded with major damage imminent.	SF		
*** {Severity M}			
c. Loose debris or trash on roof.	SF		
*** {Severity S}			
* Ponding.			
Observation:			
a. Ponding or evidence of ponding, less than ½ inch in depth.	SF		
*** {Severity M}			
b. Ponding or evidence of ponding, more than ½ inch in depth.	SF		
*** {Severity H}			

04.02 SINGLE-PLY MEMBRANE ROOFING

COMPONENTS (Continued)

◆ 04.02.02 FLASHING - MEMBRANE

Membrane flashing may be used for base flashing, expansion joints, and flashed penetrations to provide a watertight termination of the membrane cover.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Flashing damage or deterioration.			
Observation:			
a. Surface coating deterioration allowing membrane to show through.	LF		
*** {Severity L}			
b. Slippage, wrinkling, or blistering, no obvious water penetration.	LF		
*** {Severity M}			
c. Holes, splits, cuts, or tears, obvious water penetration.	LF		3
*** {Severity H}			
d. Missing flashing.	LF		3
*** {Severity H}			
* Flashing seam or side lap defects.			
Observation:			
a. Missing lap edge sealant.	LF		
*** {Severity L}			
b. Seam or side lap is open less than ½ inch into seam, no obvious water penetration.	LF		
*** {Severity L}			
c. Seam or side lap is open more than ½ inch into seam, no obvious water penetration.	LF		
*** {Severity M}			
d. Seam or side lap is open, obvious water penetration.	LF		3
*** {Severity H}			
e. Exposed gaps at top of base flashing.	LF		3
*** {Severity H}			

04.02 SINGLE-PLY MEMBRANE ROOFING

COMPONENTS (Continued)

◆ 04.02.02 FLASHING - MEMBRANE (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Membrane pipe flashing defects.			
Observation:			
a. Pipe flashing clamping ring loose or missing.	EA		
*** {Severity M}			
b. Missing or damaged pipe flashing boot.	EA		
*** {Severity H}			
* Termination bar or nailing strip defects.			
Observation:			
a. Loose or missing termination bar where no counterflashing is used.	LF		
*** {Severity M}			
b. Loose or missing nailing strip.	LF		
*** {Severity M}			
* Patched or repaired areas.			
Observation:			
a. Patching material inferior to or incompatible with existing roof membrane.	LF		
*** {Severity M}			
* Grease, solvent, or oil on flashing.			
Observation:			
a. Grease, solvent, or oil drippings, no sign of deterioration.	LF		
*** {Severity M}			
b. Grease, solvent, or oil drippings, signs of deterioration.	LF		
*** {Severity H}			
* Flashing height above roof.			
Observation:			
a. Top of base flashing is less than 6 inches above roof surface.	LF		
*** {Severity L}			

04.02 SINGLE-PLY MEMBRANE ROOFING

COMPONENTS (Continued)

◆ 04.02.03 FLASHING - METAL

Metal flashing may include base flashing, metal cap flashing, counterflashing, embedded edge metal, flashed penetrations, and pitch pans. The metal flashing is used to provide a watertight termination of the membrane.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Damaged or missing metal flashing.			
Observation:			
a. Damaged metal flashing, no obvious water penetration.	LF		
*** {Severity M}			
b. Missing or damaged metal flashing, obvious water penetration.	LF		4
*** {Severity H}			
* Loose metal flashing.			
Observation:			
a. Loose metal flashing, no obvious water penetration.	LF		
*** {Severity M}			
b. Loose metal flashing, obvious water penetration.	LF		4
*** {Severity H}			
* Corrosion.			
Observation:			
a. Surface protective coating missing (paint/galvanizing).	LF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	LF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	LF		
*** {Severity H}			

04.02 SINGLE-PLY MEMBRANE ROOFING

COMPONENTS (Continued)

◆ 04.02.03 FLASHING - METAL (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Missing flashing sealant.			
Observation:			
a. Missing flashing sealant, no obvious water penetration.	LF		
*** {Severity M}			
b. Missing flashing sealant, obvious water penetration.	LF		4
*** {Severity H}			
* Joint cover defects.			
Observation:			
a. Damaged joint covers, no obvious water penetration.	LF		
*** {Severity M}			
b. Missing or damaged joint covers, obvious water penetration.	LF		4
*** {Severity H}			
* Patched or repaired areas.			
Observation:			
a. Patching material inferior to or incompatible with existing flashing.	LF		
*** {Severity M}			

04.02 SINGLE-PLY MEMBRANE ROOFING

COMPONENTS (Continued)

◆ 04.02.03 FLASHING - METAL (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Flashed penetration defects.			
Observation:			
a. Damaged flashing sleeve, no obvious water penetration.	EA		
*** {Severity M}			
b. Pitch pan sealer is below metal rim, allowing ponding in the pan.	SF		
*** {Severity M}			
c. Missing or damaged flashing sleeve, obvious water penetration.	EA		4
*** {Severity H}			
d. Pitch pan sealer is cracked or separated from the pan or penetration.	SF		
*** {Severity H}			
e. Pitch pan perimeter metal damaged or missing.	LF		
*** {Severity H}			
* Exposed fastener defects.			
Observation:			
a. Grommet or sealant missing on exposed fasteners.	EA		
*** {Severity M}			
* Base flashing height above roof.			
Observation:			
a. Top of base flashing less than 6 inches above roof surface.	LF		
*** {Severity L}			

04.02 SINGLE-PLY MEMBRANE ROOFING

COMPONENTS (Continued)

◆ 04.02.04 INTERIOR DRAINS AND SCUPPERS

An interior drain is a penetration of the roof membrane that allows water to flow into a piped drainage system. A scupper is a channel through a parapet or raised roof edge that is designed to drain the roof.

Note: 1. Defective roof drains that are clogged internally should be addressed under 07.04 Storm Water Collection Systems. Only the strainer, bowl and clamping ring will be covered in this section.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Scupper metal deterioration or damage.			
Observation:			
a. Missing downspout straps.	EA		
*** {Severity L}			
b. Scupper shows loss of protective coating or metal corrosion.	SF		
*** {Severity M}			
c. Scupper gravel stop damaged or missing.	EA		
*** {Severity M}			
d. Scupper metal has holes present.	SF		
*** {Severity H}			
e. Collector damaged or missing.	EA		
*** {Severity H}			
f. Downspout damaged or missing.	EA		
*** {Severity H}			
* Strainer, bowl and clamp defects.			
Observation:			
a. Strainer is broken or missing.	EA		
*** {Severity M}			
b. Clamping ring loose or missing.	EA		
*** {Severity H}			
c. Drain bowl loose from roof deck or drain pipe.	EA		
*** {Severity H}			

04.02 SINGLE-PLY MEMBRANE ROOFING

REFERENCES

1. USACERL Technical Report M-92/XX, August 1992, "Membrane and Flashing Condition Indexes for Single-Ply Membrane Roofs - Inspection and Distress Manual"
2. Means Building Construction Cost Data, R.S. Means Company Inc., 1993
3. RSI 1982 Handbook of Single-Ply Roofing
4. Roof Surveys and Inspections, Roofing Industry Educational Institute

04.02 SINGLE-PLY MEMBRANE ROOFING

LEVEL II KEY GUIDE SHEET CONTROL NUMBER

N/A

LEVEL III KEY GUIDE SHEET CONTROL NUMBER

1	GS-III 04.02.01-1
2	GS-III 04.02.01-2
3	GS-III 04.02.02-3
4	GS-III 04.02.03-4

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1

COMPONENT: ROOF COVERING - SINGLE-PLY MEMBRANE
CONTROL NUMBER: GS-III 04.02.01-1

Application

This guide applies to the investigation into the extent of water intrusion under a membrane roof covering by one of three methods: nuclear, electrical capacitance or infrared thermography. Do not initiate this effort if the roofing system is covered under a current contract or warranty.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Be alert to where you walk and never back up without looking first.
2. Be especially cautious on windy days and when ice and snow are present.

Inspection Actions

1. Perform selected test to determine extent of suspected water intrusion under roof membrane.
2. Investigate surrounding area and areas beneath the roof for equipment, piping, etc. that may affect the moisture detection device responses, i.e. uninsulated steam or hot water lines below the roof surface will seriously affect infrared thermography.
3. If water intrusion is still evident, take core samples and place in sealable plastic bags for later analysis as to the moisture concentration.
4. Record location/boundaries of affected roof areas(s).
5. Patch/repair all cored areas immediately according to the membrane manufacturer's recommendations/specifications.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Nuclear Moisture Meter
2. Knife
3. Patching material
4. Adhesive
5. Sealant
6. Heat welding equipment
7. Brush
8. Infrared camera
9. Capacitance meter

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1 (Continued)

COMPONENT: ROOF COVERING - BUILT-UP MEMBRANE
CONTROL NUMBER: GS-III 04.02.01-1

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Roof Moisture Detection Methods, Building Design and Construction, October, 1983

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2

COMPONENT: ROOF COVERING - SINGLE-PLY MEMBRANE
CONTROL NUMBER: GS-III 04.02.01-2

Application

This guide applies to the investigation of depressed or soft areas under the membrane surface, by one of three methods: nuclear, electrical capacitance or infrared thermography. Do not initiate this effort if the roofing system is covered under a current contract or warranty.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Be alert to where you walk and never back up without looking first.
2. Be especially cautious on windy days and when ice and snow are present.

Inspection Actions

1. Perform selected test to determine extent of suspected water intrusion under roof membrane.
2. Investigate surrounding area and areas beneath the roof for equipment, piping, etc. that may affect the moisture detection device responses, i.e. uninsulated steam or hot water lines below the roof surface will seriously affect infrared thermography.
3. If water intrusion is still evident, take core samples and place in sealable plastic bags for later analysis as to the moisture concentration.
4. Record location/boundaries of affected roof areas(s).
5. Patch/repair all cored areas immediately according to the membrane manufacturer's recommendations/specifications.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Nuclear Moisture Meter
2. Knife
3. Patching material
4. Adhesive
5. Sealant
6. Heat welding equipment
7. Brush
8. Infrared camera
9. Capacitance meter

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2 (Continued)

COMPONENT: ROOF COVERING - BUILT-UP MEMBRANE
CONTROL NUMBER: GS-III 04.02.01-2

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Roof Moisture Detection Methods, Building Design and Construction, October, 1983

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3

COMPONENT: FLASHING - MEMBRANE
CONTROL NUMBER: GS-III 04.02.02-3

Application

This guide applies to the investigation into the extent of water intrusion under membrane flashing, by one of three methods: nuclear, electrical capacitance or infrared thermography. Do not initiate this effort if the roofing system is covered under a current contract or warranty.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Be alert to where you walk and never back up without looking first.
2. Be especially cautious on windy days and when ice and snow are present.

Inspection Actions

1. Perform selected test to determine extent of suspected water intrusion under roof membrane.
2. Investigate surrounding area and areas beneath the roof for equipment, piping, etc. that may affect the moisture detection device responses, i.e. uninsulated steam or hot water lines below the roof surface will seriously affect infrared thermography.
3. If water intrusion is still evident, take core samples and place in sealable plastic bags for later analysis as to the moisture concentration.
4. Record location/boundaries of affected roof areas(s).
5. Patch/repair all cored areas immediately according to the membrane manufacturer's recommendations/specifications.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Nuclear Moisture Meter
2. Knife
3. Patching material
4. Adhesive
5. Sealant
6. Heat welding equipment
7. Brush
8. Infrared camera
9. Capacitance meter

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3 (Continued)

COMPONENT: ROOF COVERING - BUILT-UP MEMBRANE
CONTROL NUMBER: GS-III 04.02.02-3

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Roof Moisture Detection Methods, Building Design and Construction, October, 1983

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4

COMPONENT: FLASHING - METAL
CONTROL NUMBER: GS-III 04.02.03-4

Application

This guide applies to the investigation into the extent of water intrusion under metal flashing, by one of three methods: nuclear, electrical capacitance or infrared thermography. Do not initiate this effort if the roofing system is covered under a current contract or warranty.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Be alert to where you walk and never back up without looking first.
2. Be especially cautious on windy days and when ice and snow are present.

Inspection Actions

1. Perform selected test to determine extent of suspected water intrusion under roof membrane.
2. Investigate surrounding area and areas beneath the roof for equipment, piping, etc. that may affect the moisture detection device responses, i.e. uninsulated steam or hot water lines below the roof surface will seriously affect infrared thermography.
3. If water intrusion is still evident, take core samples and place in sealable plastic bags for later analysis as to the moisture concentration.
4. Record location/boundaries of affected roof areas(s).
5. Patch/repair all cored areas immediately according to the membrane manufacturer's recommendations/specifications.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

1. Nuclear Moisture Meter
2. Knife
3. Patching material
4. Adhesive
5. Sealant
6. Heat welding equipment
7. Brush
8. Infrared camera
9. Capacitance meter

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4 (Continued)

COMPONENT: ROOF COVERING - BUILT-UP MEMBRANE
CONTROL NUMBER: GS-III 04.02.03-4

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Roof Moisture Detection Methods, Building Design and Construction, October, 1983

04.03 PANEL ROOFING

DESCRIPTION

Panel Roofing is a subsystem of the Building Roofing System. Panel roofing consists of formed-in-place or preformed units of various materials. These panels are mechanically fastened to the roof deck or framing. This subsystem also includes the flashing required to provide watertight terminations, and the roof drainage system.

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

No special tools are needed for the inspection of Panel Roofing, beyond the requirements listed in the Standard Tools Section.

SPECIAL SAFETY REQUIREMENTS

The following special safety requirements, beyond those listed in the Master Safety Plan and System Safety Section, are necessary to perform the inspection of Panel Roofing.

1. In most cases, an inspector should not walk upon a panel roof. A combination of high pitch and/or the potential for instability and damage to the panels makes these roofs dangerous. If roof access is required, life lines and catch platforms should be used if the roof pitch is 3:12 or greater. Walk boards should be used on all others.

COMPONENT LIST

- ◆ 04.03.01 ROOF COVERING - METAL PANEL
- ◆ 04.03.02 ROOF COVERING - PLASTIC PANEL
- ◆ 04.03.03 ROOF COVERING - ASBESTOS CEMENT PANEL
- ◆ 04.03.04 FLASHING - METAL

RELATED SUBSYSTEMS

Due to the related nature of the elements requiring inspection, the following should be reviewed for concurrent inspection activities. Tree limbs and branches that overhang or contact the roof surface may cause roof damage. These defects and observations should be captured in the Landscaping Subsystem.

04.08	ROOF SPECIALTIES
13.06	LANDSCAPING

04.03 PANEL ROOFING

STANDARD INSPECTION PROCEDURE

This subsystem requires a Level I inspection as part of the basic inspection process. Associated defects and observations, for each major component, are listed in the inspectors' Data Collection Devices.

The most common roof defects are panel damage caused by foot traffic, falling objects, expansion/contraction, loose fasteners, weathering of protective coatings and electrolysis from dissimilar metals.

COMPONENTS

◆ 04.03.01 ROOF COVERING - METAL PANEL

Metal panel roofing may be either preformed or site formed in varying lengths, widths, shapes and metals. The preformed panels are usually painted, galvanized or asphalt coated.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Panel damage or deterioration.			
Observation:			
a. Deteriorated or missing protective coating, some corrosion evident.	SF		
*** {Severity M}			
b. Bent or warped panels, no obvious water penetration or ponding.	SF		
*** {Severity M}			
c. Bent or warped panels, obvious water penetration or ponding.	SF		
*** {Severity H}			
d. Cracks, holes or punctures in panel, obvious water penetration.	SF		
*** {Severity H}			

04.03 PANEL ROOFING

COMPONENTS (Continued)

◆ 04.03.01 ROOF COVERING - METAL PANEL (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Lap and seam defects.			
Observation:			
a. Damaged or bent seams, no obvious water penetration.	LF		
*** {Severity L}			
b. Missing or separated panel end lap sealant.	LF		
*** {Severity M}			
c. Damaged or open seam/lap, obvious water penetration.	LF		
*** {Severity H}			
d. Missing or loose end/top closure strips.	LF		
*** {Severity H}			
* Fastener defects.			
Observation:			
a. Scattered, loose or missing fasteners or grommets, potential for panel damage.	EA		
*** {Severity M}			
b. Majority of panel fasteners loose or missing, panel damage imminent.	EA		
*** {Severity H}			

04.03 PANEL ROOFING

COMPONENTS (Continued)

◆ 04.03.02 ROOF COVERING - PLASTIC PANEL

Plastic panel roofing typically consists of preformed panels in varying lengths, widths and shapes. The panels are translucent plastic impregnated fabric sheets, usually fiberglass, formed to provide minimal structural strength.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Panel damage or deterioration.			
Observation:			
a. Crazed, deteriorated or missing surface coating, exposing fabric.	SF		
*** {Severity M}			
b. Cracked, broken or punctured panels, obvious water penetration.	SF		
*** {Severity H}			
* Lap and joint defects.			
Observation:			
a. Missing or separated panel end lap sealant.	LF		
*** {Severity M}			
b. Damaged or open joint/lap, obvious water penetration.	LF		
*** {Severity H}			
c. Missing or loose end/top closure strips.	LF		
*** {Severity H}			
* Fastener defects.			
Observation:			
a. Scattered, loose or missing fasteners or grommets, potential for panel damage.	EA		
*** {Severity M}			
b. Majority of panel fasteners loose or missing, panel damage imminent.	EA		
*** {Severity H}			

04.03 PANEL ROOFING

COMPONENTS (Continued)

◆ 04.03.03 ROOF COVERING - ASBESTOS CEMENT PANEL

Asbestos cement panel roofing consists of preformed panels of varying lengths, widths and shapes. They are composed mainly of cement and asbestos fibers formed under pressure and cured by steam. They are extremely resistant to weathering, but are brittle and require special asbestos handling methods for repair or removal.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Panel damage or deterioration.			
Observation:			
a. Deteriorated or weathered panel surface exposing asbestos fibers.	SF		
*** {Severity M}			
b. Cracked or broken panels, obvious water penetration.	SF		
*** {Severity H}			
* Lap and joint defects.			
Observation:			
a. Missing or separated end lap sealant.	LF		
*** {Severity M}			
b. Missing or loose end/top closure strips.	LF		
*** {Severity H}			
* Fastener defects.			
Observation:			
a. Scattered, loose or missing fasteners or grommets, potential for panel damage.	EA		
*** {Severity M}			
b. Majority of panel fasteners loose or missing, panel damage imminent.	EA		
*** {Severity H}			

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04.03 PANEL ROOFING

COMPONENTS (Continued)

◆ 04.03.04 FLASHING - METAL (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Valley flashing defects.			
Observation:			
a. Debris in valley blocking rapid drainage or runoff.	LF		
*** {Severity L}			
b. Separation of panels from flashing, obvious water penetration.	LF		
*** {Severity H}			
c. Open end lap seams in flashing, obvious water penetration.	LF		
*** {Severity H}			
d. Deteriorated or missing protective coating, some loss of metal thickness.	LF		
*** {Severity M}			
e. Holes, punctures, or damage, obvious water penetration.	LF		
*** {Severity H}			
* Boot and sleeve flange defects.			
Observation:			
a. Exposed or loose boot/sleeve flange.	EA		
*** {Severity M}			
b. Boot or sleeve flanges separating from panels, obvious water penetration.	EA		
*** {Severity H}			
c. Deteriorated or missing protective coating, some loss of metal thickness.	LF		
*** {Severity M}			
d. Holes, punctures, or damage, obvious water penetration.	LF		
*** {Severity H}			

04.03 PANEL ROOFING

REFERENCES

1. U.S. Army Corps of Engineer's Roofer: Membrane and Flashing Condition Indexes for Built-Up Membrane Roofs - Inspection and Distress Manual
2. Means Building Construction Cost Data, R.S. Means Company Inc., 1993
3. RSI 1982 Handbook of Single-Ply Roofing
4. Roof Surveys and Inspections, Roofing Industry Educational Institute
5. Roof Maintenance Manual, Roofing Industry Educational Institute
6. Steep Roofing Manual, Roofing Industry Educational Institute
7. Metal Roofing Systems, Robert C. Baldwin, Plant Engineering Magazine, May 17, 1979

04.03 PANEL ROOFING

LEVEL II KEY GUIDE SHEET CONTROL NUMBER

N/A

LEVEL III KEY GUIDE SHEET CONTROL NUMBER

N/A

04.04 ASPHALT ROLL ROOFING

DESCRIPTION

Asphalt Roll Roofing is a subsystem of the Building Roofing System. Asphalt roll roofing is roofing in sheet form, composed of roofing felt saturated and coated on both sides, with asphalt which generally contains fine mineral stabilizer. Asphalt roll roofing is available smooth surfaced or mineral surfaced. This subsystem also includes the flashing (membrane or metal) required to provide watertight terminations, and the roof drainage system.

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

No special tools are needed for the inspection of Asphalt Roll Roofing, beyond the requirements listed in the Standard Tools Section.

SPECIAL SAFETY REQUIREMENTS

The following special safety requirements, beyond those listed in the Master Safety Plan and System Safety Section, are necessary to perform the inspection of Asphalt Roll Roofing.

1. No special safety requirements are needed for the inspection of asphalt roll roofs, beyond the requirements listed in the Safety Section.

COMPONENT LIST

- ◆ 04.04.01 ROOF COVERING - ASPHALT ROLL MEMBRANE
- ◆ 04.04.02 FLASHING - MEMBRANE
- ◆ 04.04.03 FLASHING - METAL

RELATED SUBSYSTEMS

Due to the related nature of the elements requiring inspection, the following should be reviewed for concurrent inspection activities. Tree limbs and branches that overhang or contact the roof surface may cause roof damage. These defects and observations should be captured in the Landscaping Subsystem.

04.08	ROOF SPECIALTIES
13.06	LANDSCAPING

04.04 ASPHALT ROLL ROOFING

STANDARD INSPECTION PROCEDURE

This subsystem requires a Level I inspection as the basic inspection process. Associated defects and observations, for each major component, are listed in the inspectors' Data Collection Devices.

It may be cost effective at installations with multiple insulated roof systems to obtain an aerial infrared survey of these roofs prior to inspection or after the inspection if numerous Level III's are flagged.

The most common roof defects to be noted are missing surface coating, cuts, tears, open seams, slippage of sheets, and temporary patches.

COMPONENTS

◆ 04.04.01 ROOF COVERING - ASPHALT ROLL MEMBRANE

A roofing membrane, in sheet form, provides a watertight covering for the roof surface.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Surface defects, splits, holes, or cuts.			
Observation:			
a. Surface coating deterioration allowing membrane to show through.	SF		
*** {Severity L}			
b. Evidence of crazing, hairline cracks (alligatoring).	SF		
*** {Severity L}			
c. Severe grazing (alligatoring).	SF		
*** {Severity M}			
d. Cuts or abrasions, some membrane loss, no obvious water penetration.	SF		
*** {Severity M}			
e. Protruding underlying fasteners or other material.	SF		
*** {Severity M}			
f. Repair or unrepaired open split.	LF		
*** {Severity H}			

04.04 ASPHALT ROLL ROOFING

COMPONENTS

◆ 04.04.01 ROOF COVERING - ASPHALT ROLL MEMBRANE (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Seam defects.			
Observation:			
a. Seam is open less than ½ inch into seam, no obvious water penetration.	LF		
*** {Severity L}			
b. Seam is open more than ½ inch into seam, no obvious water penetration.	LF		
*** {Severity M}			
c. Seam is open, obvious water penetration.	LF		
*** {Severity H}			
d. Exposed nails backing out of mechanically fastened seams.	LF		
*** {Severity H}			
* Slippage.			
Observation:			
a. Less than 2 inches of slippage on a steep sloped roof.	SF		
*** {Severity L}			
b. More than 2 inches of slippage on a steep sloped roof.	SF		
*** {Severity H}			
* Patched or repaired areas.			
Observation:			
a. Patching material inferior to or incompatible with existing roof membrane.	SF		
*** {Severity M}			

04.04 ASPHALT ROLL ROOFING

COMPONENTS (Continued)

◆ 04.04.01 ROOF COVERING - ASPHALT ROLL MEMBRANE (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Grease, solvent, or oil on surface.			
Observation:			
a. Grease, solvent, or oil drippings, no sign of deterioration.	SF		
*** {Severity M}			
b. Grease, solvent, or oil drippings, signs of deterioration.	SF		
*** {Severity H}			
* Debris on roof.			
Observation:			
a. Loose debris or trash on roof.	SF		
*** {Severity S}			
b. Foreign objects left on roof, with minor damage potential.	SF		
*** {Severity L}			
c. Foreign objects left on roof, with major damage imminent.	SF		
*** {Severity M}			

04.04 ASPHALT ROLL ROOFING

COMPONENTS (Continued)

◆ 04.04.02 FLASHING - MEMBRANE

Membrane base flashing is one or more plies of material which extends from the roof surface up onto a vertical or inclined surface providing a watertight termination of the membrane. Flashing around penetrations shall also be inspected.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Surface defects, splits, holes, or cuts.			
Observation:			
a. Surface coating deterioration allowing membrane to show through. *** {Severity L}	SF		
b. Evidence of crazing, hairline cracks alligating. *** {Severity L}	SF		
c. Cuts or abrasions, some membrane loss, no obvious water penetration. *** {Severity M}	SF		
d. Protruding underlying fasteners or other material. *** {Severity M}	SF		
e. Slippage/wrinkling/blistering/pulling of base flashing material. *** {Severity M}	SF		
f. Holes, splits, cuts, or tears; obvious water penetration. *** {Severity H}	SF		
g. Missing flashing. *** {Severity H}	SF		
h. Severe grazing (alligating). *** {Severity M}	SF		
i. Repaired or unrepaired open split. *** {Severity H}	LF		

04.04 ASPHALT ROLL ROOFING

COMPONENTS (Continued)

◆ 04.04.02 FLASHING - MEMBRANE (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Seam defects.			
Observation:			
a. Seam is open less than ½ inch into seam, no obvious water penetration.	LF		
*** {Severity L}			
b. Seam is open more than ½ inch into seam, no obvious water penetration.	LF		
*** {Severity M}			
c. Seam is open, obvious water penetration.	LF		
*** {Severity H}			
d. Exposed nails backing out of mechanically fastened seams.	LF		
*** {Severity H}			
* Patched or repaired areas.			
Observation:			
a. Patching material inferior to or incompatible with existing roof membrane.	LF		
*** {Severity M}			
* Grease, solvent, or oil on flashing.			
Observation:			
a. Grease, solvent, or oil drippings, no sign of deterioration.	LF		
*** {Severity M}			
b. Grease, solvent, or oil drippings, signs of deterioration.	LF		
*** {Severity H}			

04.04 ASPHALT ROLL ROOFING

COMPONENTS (Continued)

♦ 04.04.02 FLASHING - MEMBRANE

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Exposed gaps and open side laps.			
Observation:			
a. Exposed gaps at top of flashing, no counterflashing.	LF		
*** {Severity H}			
b. Open side laps, obvious water penetration.	LF		
*** {Severity H}			
* Flashing height above roof.			
Observation:			
a. Top of base flashing is less than 6 inches above roof surface.	LF		
*** {Severity L}			

04.04 ASPHALT ROLL ROOFING

COMPONENTS (Continued)

◆ 04.04.03 FLASHING - METAL

Metal flashing provides a watertight transition of the roof covering at abrupt changes in the roof planes and at terminations. Flashing around penetrations shall also be inspected.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Step, base and cap flashing defects.			
Observation:			
a. Deteriorated or missing sealant at reglet or top of cap flashing.	LF		
*** {Severity M}			
b. Open lap or seams, obvious water penetration.	LF		
*** {Severity H}			
c. Separation of flashing from vertical surfaces, obvious water penetration.	LF		
*** {Severity H}			
d. Damaged or missing saddles/crickets at vertical walls/chimneys.	LF		
*** {Severity H}			
e. Deteriorated or missing protective coating, some loss of metal thickness.	LF		
*** {Severity M}			
f. Holes, punctures, or damage, obvious water penetration.	LF		
*** {Severity H}			

04.04 ASPHALT ROLL ROOFING

COMPONENTS (Continued)

◆ 04.04.03 FLASHING - METAL (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Valley flashing defects.			
Observation:			
a. Debris in valley blocking rapid drainage or runoff.	LF		
*** {Severity L}			
b. Separation of roof membrane from flashing, obvious water penetration.	LF		
*** {Severity H}			
c. Open end lap seams in flashing, obvious water penetration.	LF		
*** {Severity H}			
d. Deteriorated or missing protective coating, some loss of metal thickness.	LF		
*** {Severity M}			
e. Holes, punctures, or damage, obvious water penetration.	LF		
*** {Severity H}			
* Boot and sleeve flange defects.			
Observation:			
a. Exposed or loose boot/sleeve flange.	EA		
*** {Severity M}			
b. Boot or sleeve flanges separating from panels, obvious water penetration.	EA		
*** {Severity H}			
c. Deteriorated or missing protective coating, some loss of metal thickness.	LF		
*** {Severity M}			
d. Holes, punctures, or damage, obvious water penetration.	LF		
*** {Severity H}			

04.04 ASPHALT ROLL ROOFING

REFERENCES

1. TM 5-617/MO-113/AFM 91-31/MCO P11014.9, Maintenance of Repair of Roofs
2. Roof Maintenance Manual, Roofing Industry Educational Institute
3. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988
4. The NRCA Steep Roofing Manual, National Roofing Contractors Association, 1989

04.04 ASPHALT ROLL ROOFING

LEVEL II KEY GUIDE SHEET CONTROL NUMBER

N/A

LEVEL III KEY GUIDE SHEET CONTROL NUMBER

N/A

04.05 SHINGLE ROOFING

DESCRIPTION

Shingle Roofing is a subsystem of the Building Roofing System. A shingle roof covering consists of preformed bituminous, wood, slate, or cement units installed in one or more layers over the roof surface. This subsystem also includes the flashing required to provide watertight terminations, and the roof drainage system.

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

No special tools are needed for the inspection of Shingle Roofing, beyond the requirements listed in the Standard Tools Section.

SPECIAL SAFETY REQUIREMENTS

The following special safety requirements, beyond those listed in the Master Safety Plan and System Safety Section, are necessary to perform the inspection of Shingle Roofing.

1. In most cases, an inspector should not walk upon a shingle roof. A combination of high pitch and the potential for shingles to slip from under foot make these roofs dangerous. If roof access is required, life lines and catch platforms should be used if the roof pitch is 3:12 or greater.

COMPONENT LIST

- ◆ 04.05.01 ROOF COVERING - ASPHALT SHINGLES
- ◆ 04.05.02 ROOF COVERING - WOOD SHINGLES
- ◆ 04.05.03 ROOF COVERING - ASBESTOS CEMENT SHINGLES
- ◆ 04.05.04 ROOF COVERING - SLATE SHINGLES
- ◆ 04.05.05 FLASHING - METAL

RELATED SUBSYSTEMS

Due to the related nature of the elements requiring inspection, the following should be reviewed for concurrent inspection activities. Tree limbs and branches that overhang or contact the roof surface may cause roof damage. These defects and observations should be captured in the Landscaping Subsystem.

04.08	ROOF SPECIALTIES
13.06	LANDSCAPING

04.05 SHINGLE ROOFING

STANDARD INSPECTION PROCEDURE

This subsystem requires a Level I inspection as the basic inspection process. Associated defects and observations, for each major component, are listed in the inspectors' Data Collection Devices.

The most common roof defects noted include weathered, damaged or missing shingles, damaged or corroded valley and penetration flashing, and loose or missing fasteners.

COMPONENTS

◆ 04.05.01 ROOF COVERING - ASPHALT SHINGLES

An asphalt shingle is manufactured in multiple units of roofing felt that is coated with asphalt and has one side surfaced with mineral granules.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Shingle tab defects.			
Observation:			
a. Lifted or raised shingle tabs.	SF		
*** {Severity L}			
b. Loose or missing tab adhesive.	SF		
*** {Severity M}			
c. Bent or creased tabs.	SF		
*** {Severity M}			
d. Broken or missing tabs.	SF		
*** {Severity H}			
* Surface deterioration or loss of mineral granules.			
Observation:			
a. Loose or missing mineral surface granules.	SF		
*** {Severity L}			
b. Loss of granules with extensive weathering or brittle felts.	SF		
*** {Severity M}			
* Broken or deformed shingles.			
Observation:			
a. Broken, chipped, clawed, or alligatored shingles.	SF		
*** {Severity H}			

04.05 SHINGLE ROOFING

COMPONENTS

◆ 04.05.01 ROOF COVERING - ASPHALT SHINGLES (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Ridge, hip cap, woven or strip valley flashing defects.			
Observation:			
a. Cracked or missing shingle ridge, hip caps, woven or strip valley flashing.	SF		
*** {Severity H}			
* Re-roofed area defects.			
Observation:			
a. More than one re-roof over existing shingles.	SF		
*** {Severity H}			
* Nails protruding or backing out.			
Observation:			
a. Nails backing out, shingles loose but not damaged.	SF		
*** {Severity M}			
b. Nails protruding through shingles.	SF		
*** {Severity H}			
* Debris on roof.			
Observation:			
a. Foreign objects left on roof, with minor damage potential.	SF		
*** {Severity L}			
b. Foreign objects embedded in roof, major damage imminent.	SF		
*** {Severity M}			
c. Loose debris or trash on roof.	SF		
*** {Severity S}			

04.05 SHINGLE ROOFING

COMPONENTS

◆ 04.05.01 ROOF COVERING - ASPHALT SHINGLES (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Vegetation on roof.			
Observation:			
a. Evidence of vegetation, not penetrating shingles.	SF		
*** {Severity M}			
b. Evidence roots penetrating shingles.	SF		
*** {Severity H}			

04.05 SHINGLE ROOFING

COMPONENTS (Continued)

◆ 04.05.02 ROOF COVERING - WOOD SHINGLES

Wood roofing shingles are usually manufactured from red cedar, cypress or red wood. These shingles are normally laid in a three ply system.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Split, cracked, or missing shingles.			
Observation:			
a. Split or cracked shingles, no obvious water penetration.	SF		
*** {Severity L}			
b. Split, cracked, or missing shingles, exposed felts not deteriorated.	SF		
*** {Severity M}			
c. Split, cracked or missing shingles exposed felts deteriorated.	SF		
*** {Severity H}			
* Warped shingles.			
Observation:			
a. Warping of shingles, no obvious water penetration.	SF		
*** {Severity L}			
b. Warping of shingles, obvious water exposed felts not deteriorated.	SF		
*** {Severity M}			
c. Warping of shingles, exposed felts deteriorated.	SF		
*** {Severity H}			
* Loose or missing shingle nails.			
Observation:			
a. Loose or missing shingle nails.	SF		
*** {Severity H}			

04.05 SHINGLE ROOFING

COMPONENTS (Continued)

◆ 04.05.02 ROOF COVERING - WOOD SHINGLES (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Debris on roof.			
Observation:			
a. Foreign objects left on roof, with minor damage potential.	SF		
*** {Severity L}			
b. Foreign objects embedded in roof, major damage imminent.	SF		
*** {Severity M}			
c. Loose debris or trash on roof.	SF		
*** {Severity S}			
* Vegetation on roof.			
Observation:			
a. Evidence of vegetation, not penetrating shingles.	SF		
*** {Severity M}			
b. Evidence roots penetrating shingles.	SF		
*** {Severity H}			

04.05 SHINGLE ROOFING

COMPONENTS (Continued)

◆ 04.05.03 ROOF COVERING - ASBESTOS CEMENT SHINGLES

Asbestos cement shingles are composed mainly of cement and asbestos fibers formed under pressure and cured by steam. They are extremely resistant to weathering, but are brittle and require special asbestos handling methods for repair or removal.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Asbestos shingle defects.			
Observation:			
a. Cracked or loose shingle, no obvious water penetration.	SF		
*** {Severity M}			
b. Cracked, loose or missing shingle, obvious water penetration.	SF		
*** {Severity H}			
* Debris on roof.			
Observation:			
a. Foreign objects left on roof, with minor damage potential.	SF		
*** {Severity L}			
b. Foreign objects embedded in roof, major damage imminent.	SF		
*** {Severity M}			
c. Loose debris or trash on roof.	SF		
*** {Severity S}			
* Vegetation on roof.			
Observation:			
a. Evidence of vegetation, not penetrating shingles.	SF		
*** {Severity M}			
b. Evidence roots penetrating shingles.	SF		
*** {Severity H}			

04.05 SHINGLE ROOFING

COMPONENTS (Continued)

◆ 04.05.04 ROOF COVERING - SLATE SHINGLES

Slate shingles are manufactured by splitting a natural quarried rock. A thickness of about 3/16 inch is most common.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Slate shingle defects.			
Observation:			
a. Cracked or loose shingle, no obvious water penetration.	SF		
*** {Severity M}			
b. Cracked, loose or missing shingle, obvious water penetration.	SF		
*** {Severity H}			
* Debris on roof.			
Observation:			
a. Foreign objects left on roof, with minor damage potential.	SF		
*** {Severity L}			
b. Foreign objects embedded in roof, major damage imminent.	SF		
*** {Severity M}			
c. Loose debris or trash on roof.	SF		
*** {Severity S}			
* Vegetation on roof.			
Observation:			
a. Evidence of vegetation, not penetrating shingles.	SF		
*** {Severity M}			
b. Evidence roots penetrating shingles.	SF		
*** {Severity H}			

04.05 SHINGLE ROOFING

COMPONENTS (Continued)

◆ 04.05.05 FLASHING - METAL

Metal flashing provides a watertight transition of the roof covering at abrupt changes in the roof planes and at terminations. Flashing around penetrations shall also be inspected.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Step, base and cap flashing defects.			
Observation:			
a. Deteriorated or missing sealant at reglet or top of cap flashing.	LF		
*** {Severity M}			
b. Open lap or seams, obvious water penetration.	LF		
*** {Severity H}			
c. Separation of flashing from vertical surfaces, obvious water penetration.	LF		
*** {Severity H}			
d. Damaged or missing saddles/crickets at vertical walls/chimneys.	LF		
*** {Severity H}			
e. Deteriorated or missing protective coating, some loss of metal thickness.	LF		
*** {Severity M}			
f. Holes, punctures, or damage, obvious water penetration.	LF		
*** {Severity H}			

04.05 SHINGLE ROOFING

COMPONENTS (Continued)

◆ 04.05.05 FLASHING - METAL (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Valley flashing defects.			
Observation:			
a. Debris in valley blocking rapid drainage or runoff.	LF		
*** {Severity L}			
b. Separation of shingles from flashing, obvious water penetration.	LF		
*** {Severity H}			
c. Open end lap seams in flashing, obvious water penetration.	LF		
*** {Severity H}			
d. Separation of shingles from flashing, obvious water penetration.	LF		
*** {Severity H}			
e. Open end lap seams in flashing, obvious water penetration.	LF		
*** {Severity H}			
* Boot and sleeve flange defects.			
Observation:			
a. Exposed or loose boot/sleeve flange.	EA		
*** {Severity M}			
b. Boot or sleeve flanges separating from panels, obvious water penetration.	EA		
*** {Severity H}			
c. Deteriorated or missing protective coating, some loss of metal thickness.	LF		
*** {Severity M}			
d. Holes, punctures, or damage, obvious water penetration.	LF		
*** {Severity H}			

04.05 SHINGLE ROOFING

REFERENCES

1. TM 5-617/MO-113/AFM 91-31/MCOP 11014.9, Maintenance and Repair of Roofs
2. Roof Surveys and Inspections, the Roofing Industry Educational Institute
3. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988
4. Steep Roofing Manual, The Roofing Industry Educational Institute

04.05 SHINGLE ROOFING

LEVEL II KEY GUIDE SHEET CONTROL NUMBER

N/A

LEVEL III KEY GUIDE SHEET CONTROL NUMBER

N/A

04.06 TILE ROOFING

DESCRIPTION

Tile Roofing is a subsystem of the Building Roofing System. Tile roof coverings are usually clay or shale products that are burned into a hard, dense structure, or a cement product pressed and cured under controlled conditions to reach required strength. This subsystem also includes the flashing required to provide watertight terminations, and the roof drainage system.

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

No special tools are needed for the inspection of Tile Roofing, beyond the requirements listed in the Standard Tools Section.

SPECIAL SAFETY REQUIREMENTS

The following special safety requirements, beyond those listed in the Master Safety Plan and System Safety Section, are necessary to perform the inspection of Tile Roofing.

1. In most cases, an inspector should not walk upon a tile roof. A combination of high pitch and the potential for shingles to slip from under foot make these roofs dangerous. If roof access is required, life lines, walk boards, and catch platforms should be used if the roof pitch is 3:12 or greater.

COMPONENT LIST

- ◆ 04.06.01 ROOF COVERING - ROLL TILE
- ◆ 04.06.02 ROOF COVERING - FLAT TILE
- ◆ 04.06.03 FLASHING - METAL

RELATED SUBSYSTEMS

Due to the related nature of the elements requiring inspection, the following should be reviewed for concurrent inspection activities. Tree limbs and branches that overhang or contact the roof surface may cause roof damage. These defects and observations should be captured in the Landscaping Subsystem.

04.08	ROOF SPECIALTIES
13.06	LANDSCAPING

04.06 TILE ROOFING

STANDARD INSPECTION PROCEDURE

This subsystem requires a Level I inspection as the basic inspection process. Associated defects and observations, for each major component, are listed in the inspectors' Data Collection Devices.

The most common roof defects include broken or missing tiles, loose or missing fasteners, and missing closure tiles.

COMPONENTS

♦ 04.06.01 ROOF COVERING - ROLL TILE

Roll roof tiles are usually barrel/mission or spanish "S" in shape. The barrel/mission tiles are nailed to a nailing strip, while the spanish "S" tiles are nailed directly to the deck.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Roof field tile defects.			
Observation:			
a. Cracked or loose tiles, no obvious water penetration.	EA		
*** {Severity M}			
b. Cracked or loose eave closure, no obvious water penetration, deck not exposed.	EA		
*** {Severity M}			
c. Broken or missing eave closure, obvious water penetration, deck exposed.	EA		
*** {Severity H}			
d. Broken or missing tiles, no felt deterioration.	EA		
*** {Severity M}			
e. Broken or missing tiles, felt deterioration.	EA		
*** {Severity H}			

04.06 TILE ROOFING

COMPONENTS (Continued)

◆ 04.06.01 ROOF COVERING - ROLL TILE (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Roof gable rake tiles.			
Observation:			
a. Cracked or loose gable rake tiles, no obvious water penetration, deck not exposed.	EA		
*** {Severity M}			
b. Broken or missing gable rake tiles, obvious water penetration, deck exposed.	EA		
*** {Severity H}			
* Hip and ridge cover defects.			
Observation:			
a. Cracked or loose tiles, no obvious water penetration.	EA		
*** {Severity M}			
b. Loose or missing tile or cement top fixtures, no obvious water penetration.	EA		
*** {Severity M}			
c. Loose or missing tile or cement top fixtures, obvious water penetration.	EA		
*** {Severity H}			
d. Broken, loose, or missing tiles, exposed felt not deteriorated.	EA		
*** {Severity M}			
e. Broken, loose or missing tiles, exposed felt deteriorated.	EA		
*** {Severity H}			

04.06 TILE ROOFING

COMPONENTS (Continued)

◆ 04.06.01 ROOF COVERING - ROLL TILE (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Debris on roof.			
Observation:			
a. Foreign objects left on roof, with minor damage potential.	SF		
*** {Severity L}			
b. Foreign objects embedded in roof, major damage imminent.	SF		
*** {Severity M}			
c. Loose debris or trash on roof.	SF		
*** {Severity S}			
* Vegetation on roof.			
Observation:			
a. Evidence of vegetation, not penetrating tile joints.	SF		
*** {Severity M}			
b. Evidence roots penetrating tile joints.	SF		
*** {Severity H}			

04.06 TILE ROOFING

COMPONENTS (Continued)

◆ 04.06.02 ROOF COVERING - FLAT TILE

Flat tile roof units are either interlocking unlugged or lugged shingles. Tiles may be mortared in place on roof slopes of 5:12 or less, but are mechanically fastened on slopes greater than 5:12.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Roof field tile defects.			
Observation:			
a. Cracked or loose tile units, no obvious water penetration.	EA		
*** {Severity M}			
b. Loose or missing under-eave course units.	EA		
*** {Severity M}			
c. Loose or missing mortar at roof edge side gap.	LF		
*** {Severity M}			
d. Broken or missing tile units, exposed felts not deteriorated.	EA		
*** {Severity H}			
e. Broken or missing tile units, exposed felt deteriorated.	EA		
*** {Severity H}			
* Hip and ridge cover defects.			
Observation:			
a. Cracked or loose tiles, no obvious water penetration.	EA		
*** {Severity M}			
b. Broken or missing tiles, obvious water penetration.	EA		
*** {Severity H}			

04.06 TILE ROOFING

COMPONENTS (Continued)

◆ 04.06.03 FLASHING - METAL

Metal flashing provides a watertight transition of the roof covering at abrupt changes in the roof planes and at terminations. Flashing around penetrations shall also be inspected.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Step, base and cap flashing defects.			
Observation:			
a. Deteriorated or missing sealant at reglet or top of cap flashing.	LF		
*** {Severity M}			
b. Open lap or seams, obvious water penetration.	LF		
*** {Severity H}			
c. Separation of flashing from vertical surfaces, obvious water penetration.	LF		
*** {Severity H}			
d. Damaged or missing saddles/crickets at vertical walls/chimneys.	LF		
*** {Severity H}			
e. Deteriorated or missing protective coating, some loss of metal thickness.	LF		
*** {Severity M}			
f. Holes, punctures, or damage, obvious water penetration.	LF		
*** {Severity H}			

04.06 TILE ROOFING

COMPONENTS (Continued)

◆ 04.06.03 FLASHING - METAL (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Valley flashing defects.			
Observation:			
a. Debris in valley blocking rapid drainage or runoff.	LF		
*** {Severity L}			
b. Separation of shingles from flashing, obvious water penetration.	LF		
*** {Severity H}			
c. Open end lap seams in flashing, obvious water penetration.	LF		
*** {Severity H}			
d. Deteriorated or missing protective coating, some loss of metal thickness.	LF		
*** {Severity M}			
e. Holes, punctures, or damage, obvious water penetration.	LF		
*** {Severity H}			
* Boot and sleeve flange defects.			
Observation:			
a. Exposed or loose boot/sleeve flange.	EA		
*** {Severity M}			
b. Boot or sleeve flanges separating from panels, obvious water penetration.	EA		
*** {Severity H}			
c. Deteriorated or missing protective coating, some loss of metal thickness.	LF		
*** {Severity M}			
d. Holes, punctures, or damage, obvious water penetration.	LF		
*** {Severity H}			

04.06 TILE ROOFING

REFERENCES

1. TM 5-617/MO-113/AFM 91-34/MCO P11014.9, Maintenance and Repair of Roofs
2. Roof Maintenance, Roofing Industry Educational Institute
3. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988
4. The NRCA Steep Roofing Manual, National Roofing Contractors Association, 1989

04.06 TILE ROOFING

LEVEL II KEY	GUIDE SHEET CONTROL NUMBER
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N/A

LEVEL III KEY	GUIDE SHEET CONTROL NUMBER
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N/A

04.07 FLUID APPLIED MEMBRANE ROOFING

DESCRIPTION

Fluid Applied Membrane Roofing is a subsystem of the Building Roofing System. Fluid applied membrane roofing is primarily utilized on flat or curved roof decks to extend the life of deteriorating built-up roofing. They also provide roof covering for unusually shaped decks, and decks containing extensive and complex mechanical equipment. The coatings are also used to provide a protective coating for sprayed-on polyurethane foam insulation. This subsystem also includes the flashing (membrane or metal) required to provide watertight terminations, and the interior drains and scuppers required to shed water from the roof surface.

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

No special tools are needed for the inspection of Fluid Applied Membrane Roofing, beyond the requirements listed in the Standard Tools Section.

SPECIAL SAFETY REQUIREMENTS

The following special safety requirements, beyond those listed in the Master Safety Plan and System Safety Section, are necessary to perform the inspection of Fluid Applied Membrane Roofing.

1. Fluid applied membrane roofs require care when being walked upon to prevent membrane damage.

COMPONENT LIST

- ◆ 04.07.01 ROOF COVERING - FLUID APPLIED MEMBRANE
- ◆ 04.07.02 FLASHING - MEMBRANE
- ◆ 04.07.03 FLASHING - METAL
- ◆ 04.07.04 INTERIOR DRAINS AND SCUPPERS

RELATED SUBSYSTEMS

Due to the related nature of the elements requiring inspection, the following should be reviewed for concurrent inspection activities. Tree limbs and branches that overhang or contact the roof surface may cause roof damage. These defects and observations should be captured in the Landscaping Subsystem.

04.08	ROOF SPECIALTIES
13.06	LANDSCAPING

04.07 FLUID APPLIED MEMBRANE ROOFING

STANDARD INSPECTION PROCEDURE

This subsystem requires a Level I inspection as part of the basic inspection process. Associated defects and observations, for each major component, are listed in the inspectors' Data Collection Devices.

The most common roof defects are splits, penetrations, and tears from foot traffic, falling objects, separation from flashing and vertical walls, and splitting caused by movements of the roof deck.

COMPONENTS

◆ 04.07.01 ROOF COVERING - FLUID APPLIED MEMBRANE

Fluid applied or sprayed-on roofs are available in a variety of elastomeric materials applied to thickness of 25 to 60 mils in one or more coats. Each type of elastomeric material offers varying degrees of resistance to foot traffic, ultraviolet rays, temperature and ease of repair. In some instances, the membrane is placed on a sprayed-on polyurethane foam (PUF) insulation as a protective coating.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Surface defects, splits, holes, or cuts.			
Observation:			
a. Membrane weathered, scuffed or abraded, no obvious water penetration.	SF		
*** {Severity L}			
b. Holes, splits or tears, obvious water penetration or exposed insulation.	SF		1
*** {Severity H}			
* Debris on roof.			
Observation:			
a. Foreign objects left on roof, with minor damage potential.	SF		
*** {Severity L}			
b. Foreign objects left on roof, embedded with major damage imminent.	SF		
*** {Severity M}			
c. Loose debris or trash on roof.	SF		
*** {Severity S}			

04.07 FLUID APPLIED MEMBRANE ROOFING

COMPONENTS (Continued)

◆ 04.07.01 ROOF COVERING - FLUID APPLIED MEMBRANE (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Ponding.			
Observation:			
a. Ponding or evidence of ponding, less than ½ inch in depth.	SF		
*** {Severity L}			
b. Ponding or evidence of ponding, more than ½ inch in depth.	SF		
*** {Severity H}			
* Substrate failure.			
Observation:			
a. Depressed or soft areas under membrane.	SF		2
*** {Severity H}			
* Membrane deformation.			
Observation:			
a. Membrane deformation, bridging over misaligned substrate, less than 2" deflection.	LF		
*** {Severity L}			
b. Membrane deformation, bridging over misaligned substrate, greater than 2" deflection.	LF		
*** {Severity M}			
c. Membrane stretched, delaminated from substrate, by negative pressure lifting.	SF		
*** {Severity H}			
* Patched or repaired areas.			
Observation:			
a. Patching material inferior to or incompatible with existing roof membrane.	LF		
*** {Severity M}			

04.07 FLUID APPLIED MEMBRANE ROOFING

COMPONENTS (Continued)

◆ 04.07.01 ROOF COVERING - FLUID APPLIED MEMBRANE (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Grease, solvent, or oil on surface.			
Observation:			
a. Grease, solvent, or oil drippings, no sign of deterioration.	SF		
*** {Severity M}			
b. Grease, solvent, or oil drippings, signs of deterioration.	SF		
*** {Severity H}			

04.07 FLUID APPLIED MEMBRANE ROOFING

COMPONENTS (Continued)

◆ 04.07.02 FLASHING - MEMBRANE

Membrane base flashing is one or more coats of fluid applied material which extends from the roof surface up onto a vertical or inclined surface providing a watertight termination of the membrane.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Surface defects, splits, holes, or cuts.			
Observation:			
a. Membrane weathered, scuffed or abraded no obvious water penetration.	SF		
*** {Severity L}			
b. Membrane separating from substrate or metal flashing, no obvious water penetration.	LF		
*** {Severity M}			
c. Cuts, holes, splits or missing membrane, obvious water penetration.	SF		3
*** {Severity H}			
* Patched or repaired areas.			
Observation:			
a. Patching material inferior to or incompatible with existing roof membrane.	LF		
*** {Severity M}			
* Grease, solvent, or oil on flashing.			
Observation:			
a. Grease, solvent, or oil drippings, no sign of deterioration.	LF		
*** {Severity M}			
b. Grease, solvent, or oil drippings, signs of deterioration.	LF		
*** {Severity H}			
* Exposed gaps.			
Observation:			
a. Exposed gaps at top of flashing, no counterflashing.	LF		3
*** {Severity H}			

04.07 FLUID APPLIED MEMBRANE ROOFING

COMPONENTS (Continued)

♦ 04.07.02 FLASHING - MEMBRANE (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Flashing height above roof.			
Observation:			
a. Top of base flashing is less than 6 inches above roof surface.	LF		
*** {Severity L}			

04.07 FLUID APPLIED MEMBRANE ROOFING

COMPONENTS (Continued)

◆ 04.07.03 FLASHING - METAL

Metal flashing may include base flashing, metal cap flashing, counterflashing, embedded edge metal, flashed penetration, and pitch pans. The metal flashing is used to provide a watertight termination of the membrane.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Damaged or missing metal flashing.			
Observation:			
a. Damaged metal flashing, no obvious water penetration.	LF		
*** {Severity M}			
b. Missing or damaged metal flashing, obvious water penetration.	LF		4
*** {Severity H}			
* Loose metal flashing.			
Observation:			
a. Loose metal flashing, no obvious water penetration.	LF		
*** {Severity M}			
b. Loose metal flashing, obvious water penetration.	LF		4
*** {Severity H}			
* Corrosion.			
Observation:			
a. Surface protective coating missing (paint/galvanizing).	LF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	LF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	LF		
*** {Severity H}			

04.07 FLUID APPLIED MEMBRANE ROOFING

COMPONENTS (Continued)

◆ 04.07.03 FLASHING - METAL (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Missing flashing sealant.			
Observation:			
a. Missing flashing sealant, no obvious water penetration.	LF		
*** {Severity M}			
b. Missing flashing sealant, obvious water penetration.	LF		4
*** {Severity H}			
* Joint cover defects.			
Observation:			
a. Damaged joint covers, no obvious water penetration.	LF		
*** {Severity M}			
b. Missing or damaged joint covers, obvious water penetration.	LF		4
*** {Severity H}			
* Patched or repaired areas.			
Observation:			
a. Patching material inferior to or incompatible with existing flashing.	LF		
*** {Severity M}			

04.07 FLUID APPLIED MEMBRANE ROOFING

COMPONENTS (Continued)

◆ 04.07.03 FLASHING - METAL (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Flashed penetration defects.			
Observation:			
a. Damaged flashing sleeve, no obvious water penetration.	EA		
*** {Severity M}			
b. Pitch pan sealer is below metal rim, allowing ponding in the pan.	SF		
*** {Severity M}			
c. Missing or damaged flashing sleeve, obvious water penetration.	EA		4
*** {Severity H}			
d. Pitch pan sealer is cracked or separated from the pan or penetration.	SF		
*** {Severity H}			
e. Pitch pan perimeter metal damaged or missing.	LF		
*** {Severity H}			
* Exposed fastener defects.			
Observation:			
a. Grommet or sealant missing on exposed fasteners.	EA		
*** {Severity M}			
* Base flashing height above roof.			
Observation:			
a. Top of base flashing less than 6 inches above roof surface.	LF		
*** {Severity L}			

04.07 FLUID APPLIED MEMBRANE ROOFING

COMPONENTS (Continued)

◆ 04.07.04 INTERIOR DRAINS AND SCUPPERS

An interior drain is a penetration of the roof membrane that allows water to flow into a piped drainage system. A scupper is a channel through a parapet or raised roof edge that is designed to drain the roof.

Note: 1. Defective roof drains that are clogged internally should be addressed under 07.04 Storm Water Collection System. Only the strainer, bowl and clamping ring will be covered in this section.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Scupper metal deterioration or damage.			
Observation:			
a. Missing downspout straps.	EA		
*** {Severity L}			
b. Scupper shows loss of protective coating or metal corrosion.	SF		
*** {Severity M}			
c. Scupper gravel stop damaged or missing.	EA		
*** {Severity M}			
d. Scupper metal has holes present.	SF		
*** {Severity H}			
e. Collector damaged or missing.	EA		
*** {Severity H}			
f. Downspout damaged or missing.	EA		
*** {Severity H}			
* Strainer, bowl and clamp defects.			
Observation:			
a. Strainer is broken or missing.	EA		
*** {Severity M}			
b. Clamping ring loose or missing.	EA		
*** {Severity H}			
c. Drain bowl loose from roof deck or drain pipe.	EA		
*** {Severity H}			

04.07 FLUID APPLIED MEMBRANE ROOFING

REFERENCES

1. U.S. Army Corps of Engineer's Roofer: Membrane and Flashing Condition Indexes for Built-Up Membrane Roofs - Inspection and Distress Manual.
2. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988
3. Carboline - Building Products Division, Roofing Seminar Notes / 092482
4. Roof Surveys and Inspections, Roofing Industry Educational Institute
5. ASI Specifications "Reroofing with Sprayed-In-Place Polyurethane Insulating Foam and Fluid Applied Roof Coating", Acoustical Spray Insulators, Inc.
6. Guide Specification - Fluid Applied Roofing - Section 07540, Carpenter Insulation and Coatings Co., Dallas, Texas
7. Roof Maintenance Manual, Roofing Industry Educational Institute
8. Manual of Roof Maintenance and Repair, NRCA/ARMA, 1988

04.07 FLUID APPLIED MEMBRANE ROOFING

LEVEL II KEY GUIDE SHEET CONTROL NUMBER

N/A

LEVEL III KEY GUIDE SHEET CONTROL NUMBER

1	GS-III 04.07.01-1
2	GS-III 04.07.01-2
3	GS-III 04.07.02-3
4	GS-III 04.07.03-4

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1

COMPONENT: ROOF COVERING - FLUID APPLIED MEMBRANE
CONTROL NUMBER: GS-III 04.07.01-1

Application

This guide applies to the investigation into the extent of water intrusion under a fluid applied membrane roof covering by one of three methods: nuclear, electrical capacitance or infrared thermography. Do not initiate this effort if the roofing system is covered under a current contract or warranty.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Be alert to where you walk and never back up without looking first.
2. Be especially cautious on windy days and when ice and snow are present.

Inspection Actions

1. Perform selected test to determine extent of suspected water intrusion under roof membrane.
2. Investigate surrounding area and areas beneath the roof for equipment, piping, etc. that may affect the moisture detection device responses, i.e. uninsulated steam or hot water lines below the roof surface will seriously affect infrared thermography.
3. If water intrusion is still evident, take core samples and place in sealable plastic bags for later analysis as to the moisture concentration.
4. Record location/boundaries of affected roof areas(s).
5. Patch/repair all cored areas immediately according to the membrane manufacturer's recommendations/specifications.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

- | | |
|---------------------------|---------------------------|
| 1. Nuclear Moisture Meter | 6. Heat welding equipment |
| 2. Knife | 7. Brush |
| 3. Patching material | 8. Infrared camera |
| 4. Adhesive | 9. Capacitance meter |
| 5. Sealant | |

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 1 (Continued)

COMPONENT: ROOF COVERING - FLUID APPLIED MEMBRANE
CONTROL NUMBER: GS-III 04.07.01-1

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

References

1. Roof Moisture Detection Methods, Building Design and Construction, October, 1983

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2

COMPONENT: ROOF COVERING - FLUID APPLIED MEMBRANE
CONTROL NUMBER: GS-III 04.07.01-2

Application

This guide applies to the investigation of depressed or soft areas under the membrane surface, by one of three methods: nuclear, electrical capacitance or infrared thermography. Do not initiate this effort if the roofing system is covered under a current contract or warranty.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Be alert to where you walk and never back up without looking first.
2. Be especially cautious on windy days and when ice and snow are present.

Inspection Actions

1. Perform selected test to determine extent of suspected water intrusion under roof membrane.
2. Investigate surrounding area and areas beneath the roof for equipment, piping, etc. that may affect the moisture detection device responses, i.e. uninsulated steam or hot water lines below the roof surface will seriously affect infrared thermography.
3. If water intrusion is still evident, take core samples and place in sealable plastic bags for later analysis as to the moisture concentration.
4. Record location/boundaries of affected roof areas(s).
5. Patch/repair all cored areas immediately according to the membrane manufacturer's recommendations/specifications.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

- | | |
|---------------------------|---------------------------|
| 1. Nuclear Moisture Meter | 6. Heat welding equipment |
| 2. Knife | 7. Brush |
| 3. Patching material | 8. Infrared camera |
| 4. Adhesive | 9. Capacitance meter |
| 5. Sealant | |

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 2 (Continued)

COMPONENT: ROOF COVERING - BUILT-UP MEMBRANE
CONTROL NUMBER: GS-III 04.07.01-2

References

1. Roof Moisture Detection Methods, Building Design and Construction, October, 1983

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3

COMPONENT: FLASHING - MEMBRANE
CONTROL NUMBER: GS-III 04.07.02-3

Application

This guide applies to the investigation into the extent of water intrusion under membrane flashing, by one of three methods: nuclear, electrical capacitance or infrared thermography. Do not initiate this effort if the roofing system is covered under a current contract or warranty.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Be alert to where you walk and never back up without looking first.
2. Be especially cautious on windy days and when ice and snow are present.

Inspection Actions

1. Perform selected test to determine extent of suspected water intrusion under roof membrane.
2. Investigate surrounding area and areas beneath the roof for equipment, piping, etc. that may affect the moisture detection device responses, i.e. uninsulated steam or hot water lines below the roof surface will seriously affect infrared thermography.
3. If water intrusion is still evident, take core samples and place in sealable plastic bags for later analysis as to the moisture concentration.
4. Record location/boundaries of affected roof areas(s).
5. Patch/repair all cored areas immediately according to the membrane manufacturer's recommendations/specifications.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

- | | |
|---------------------------|---------------------------|
| 1. Nuclear Moisture Meter | 6. Heat welding equipment |
| 2. Knife | 7. Brush |
| 3. Patching material | 8. Infrared camera |
| 4. Adhesive | 9. Capacitance meter |
| 5. Sealant | |

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors

LEVEL III INSPECTION METHOD GUIDE SHEET

such as problematic conditions.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 3 (Continued)

COMPONENT: ROOF COVERING - BUILT-UP MEMBRANE
CONTROL NUMBER: GS-III 04.07.02-3

References

1. Roof Moisture Detection Methods, Building Design and Construction, October, 1983

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4

COMPONENT: FLASHING - METAL
CONTROL NUMBER: GS-III 04.07.03-4

Application

This guide applies to the investigation into the extent of water intrusion under metal flashing, by one of three methods: nuclear, electrical capacitance or infrared thermography. Do not initiate this effort if the roofing system is covered under a current contract or warranty.

Special Safety Requirements

The following is a list of special safety requirements beyond those listed in the Master Safety Plan and System Safety Section.

1. Be alert to where you walk and never back up without looking first.
2. Be especially cautious on windy days and when ice and snow are present.

Inspection Actions

1. Perform selected test to determine extent of suspected water intrusion under roof membrane.
2. Investigate surrounding area and areas beneath the roof for equipment, piping, etc. that may affect the moisture detection device responses, i.e. uninsulated steam or hot water lines below the roof surface will seriously affect infrared thermography.
3. If water intrusion is still evident, take core samples and place in sealable plastic bags for later analysis as to the moisture concentration.
4. Record location/boundaries of affected roof areas(s).
5. Patch/repair all cored areas immediately according to the membrane manufacturer's recommendations/specifications.

Special Tools and Equipment

The following is a list of special tools and equipment beyond those listed in the Standard Tool Section.

- | | |
|---------------------------|---------------------------|
| 1. Nuclear Moisture Meter | 6. Heat welding equipment |
| 2. Knife | 7. Brush |
| 3. Patching material | 8. Infrared camera |
| 4. Adhesive | 9. Capacitance meter |
| 5. Sealant | |

Recommended Inspection Frequency

Perform inspection when triggered by Level I and Level II inspections or other local factors such as problematic conditions.

LEVEL III INSPECTION METHOD GUIDE SHEET

LEVEL III GUIDE SHEET - KEY NO. 4 (Continued)

COMPONENT: ROOF COVERING - BUILT-UP MEMBRANE
CONTROL NUMBER: GS-III 04.07.03-4

References

1. Roof Moisture Detection Methods, Building Design and Construction, October, 1983

04.08 ROOF SPECIALTIES

DESCRIPTION

Roof Specialties is a subsystem of the Building Roofing System. Roof specialties are devices included as part of the roof covering system, whose primary purpose is to support the roof service life and other building functions.

SPECIAL TOOL AND EQUIPMENT REQUIREMENTS

No special tools are needed for the inspection of Roof Specialties, beyond the requirements listed in the Standard Tools Section.

SPECIAL SAFETY REQUIREMENTS

No special safety requirements are needed for the inspection of Roof Specialties, beyond the requirements listed in the Master Safety Plan and System Safety Section.

COMPONENT LIST

- ◆ 04.08.01 ROOF HATCHES
- ◆ 04.08.02 ROOF HATCH - HARDWARE
- ◆ 04.08.03 ROOF VENTS
- ◆ 04.08.04 SKYLIGHTS AND SKY ROOFS
- ◆ 04.08.05 SKYLIGHT AND SKY ROOF - HARDWARE
- ◆ 04.08.06 SNOW CLEATS
- ◆ 04.08.07 RUN-OFF DIVERTERS

RELATED SUBSYSTEMS

Due to the related nature of the elements requiring inspection, the following should be reviewed for concurrent inspection activities.

- 04.01 BUILT-UP MEMBRANE ROOFING
- 04.02 SINGLE-PLY MEMBRANE ROOFING
- 04.03 PANEL ROOFING
- 04.04 ASPHALT ROLL ROOFING
- 04.05 SHINGLE ROOFING
- 04.06 TILE ROOFING
- 04.07 FLUID APPLIED MEMBRANE ROOFING

04.08 ROOF SPECIALTIES

STANDARD INSPECTION PROCEDURE

This subsystem requires a Level I inspection as the basic inspection process. Associated defects and observations, for each major component, are listed in the inspectors' Data Collection Devices.

The most common roof defects noted on roof specialties are broken glass, deteriorated plastic, missing or deteriorated seals, loose fasteners, damaged or missing hatch hardware and damaged metal or wood frames and coverings.

COMPONENTS

◆ 04.08.01 ROOF HATCHES

Roof hatches include scuttles, which are installed to provide access to the roof, and smoke vents, which provide automatic heat and smoke release in case of fire. Scuttles may be manually operated or motorized. They are constructed of wood and/or metal and may have minimal or no hardware. Smoke vents have a fusible link or some other device to release the hatch door when heat and/or smoke is detected. Roof hatch hardware is covered in section 04.08.02.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Protective coating defects.			
Observation:			
a. Surface protective coating missing (paint/galvanizing).	SF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	SF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	SF		
*** {Severity H}			
* Deteriorated wood hatch cover.			
Observation:			
a. Broken, split or damaged hatch.	SF		
*** {Severity H}			

04.08 ROOF SPECIALTIES

COMPONENTS (Continued)

◆ 04.08.01 ROOF HATCHES (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Damaged hatch cover.			
Observation:			
a. Physically damaged hatch door, no water penetration.	SF		
*** {Severity M}			
b. Damaged hatch door, obvious water penetration.	SF		
*** {Severity H}			
* Damaged hatch curb.			
Observation:			
a. Physically damaged hatch curb, no water penetration.	LF		
*** {Severity M}			
b. Physically damaged hatch curb, obvious water penetration.	LF		
*** {Severity H}			
* Cracked, damaged or missing seals or gaskets.			
Observation:			
a. Cracked or damaged seals or gaskets, no obvious water penetration.	LF		
*** {Severity M}			
b. Torn, broken or missing seals or gaskets, obvious water penetration.	LF		
*** {Severity H}			

04.08 ROOF SPECIALTIES

COMPONENTS (Continued)

◆ 04.08.02 ROOF HATCH - HARDWARE

Roof hatch hardware includes fusible link mechanisms, latches, compression springs, hinges and manual operating devices.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Hardware defects.			
Observation:			
a. Weak or inoperative compression spring.	EA		
*** {Severity L}			
b. Damaged or defective cover hinge system.	EA		
*** {Severity M}			
c. Damaged latch mechanism, still functioning.	EA		
*** {Severity M}			
d. Missing latch mechanism, inoperable.	EA		
*** {Severity H}			
e. Missing or inoperative fusible linkage on smoke vent.	EA		
*** {Severity H}			
f. Damaged or inoperative manual operating mechanism.	EA		
*** {Severity H}			

04.08 ROOF SPECIALTIES

COMPONENTS (Continued)

◆ 04.08.03 ROOF VENTS

Roof vents are devices installed in the roof system to remove excess heat from the underside of the roof or to remove moisture trapped within the roof system. The devices are commonly made of metal and protrude above the roof surface or are integrated into edge or ridge flashing.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Damaged or missing metal roof vents.			
Observation:			
a. Missing or damaged bird screen.	LF		
*** {Severity L}			
b. Damaged metal roof vent, no obvious water penetration.	LF		
*** {Severity M}			
c. Missing or damaged metal roof vent, obvious water penetration.	LF		
*** {Severity H}			
* Loose metal roof vent.			
Observation:			
a. Loose metal roof vent, no obvious water penetration.	LF		
*** {Severity M}			
b. Loose metal roof vent, obvious water penetration.	LF		
*** {Severity H}			
* Corrosion.			
Observation:			
a. Surface protective coating missing (paint/galvanizing).	LF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	LF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	LF		
*** {Severity H}			

04.08 ROOF SPECIALTIES

COMPONENTS (Continued)

◆ 04.08.03 ROOF VENTS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Joint cover defects.			
Observation:			
a. Damaged joint covers, no obvious water penetration.	LF		
*** {Severity M}			
b. Missing or damaged joint covers, obvious water penetration.	LF		
*** {Severity H}			
* Patched or repaired areas.			
Observation:			
a. Patching material inferior to or incompatible with existing material.	LF		
*** {Severity M}			

04.08 ROOF SPECIALTIES

COMPONENTS (Continued)

◆ 04.08.04 SKYLIGHTS AND SKY ROOFS

Skylights and sky roofs are openings in the roof system which are glazed with a transparent or translucent material to admit light to the space below. They are commonly framed in wood or metal and mounted on curbs. They may be fixed, manual or automatic opening. Some may serve as smoke vents containing fusible links. Skylight and sky roof hardware are covered in section 04.08.05.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Protective coating defects.			
Observation:			
a. Surface protective coating missing (paint/galvanizing).	LF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	LF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	LF		
*** {Severity H}			
* Curb or frame defects.			
Observation:			
a. Damaged or loose framing, no obvious water penetration.	LF		
*** {Severity M}			
b. Damaged or loose framing, obvious water penetration.	LF		
*** {Severity H}			
c. Damaged curbing.	LF		
*** {Severity H}			
* Deteriorated wood frame.			
Observation:			
a. Broken, split or damaged wood frame.	LF		
*** {Severity H}			

04.08 ROOF SPECIALTIES

COMPONENTS (Continued)

◆ 04.08.04 SKYLIGHTS AND SKY ROOFS (Continued)

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Panel defects.			
Observation:			
a. Cracked or crazed glass or plastic panels, no obvious water penetration.	SF		
*** {Severity L}			
b. Cracked or damaged sealant or gaskets, no obvious water penetration.	LF		
*** {Severity M}			
c. Broken or missing glass or plastic panels, obvious water penetration.	SF		
*** {Severity H}			
d. Open or missing sealant or gaskets, obvious water penetration.	LF		
*** {Severity H}			
e. Loose purlin, eave or rafter caps.	LF		
*** {Severity H}			

04.08 ROOF SPECIALTIES

COMPONENTS (Continued)

◆ 04.08.05 SKYLIGHT AND SKY ROOF - HARDWARE

Skylight and sky roof hardware include fusible link mechanisms, latches, compression springs, hinges and manual operating devices.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Hardware defects.			
Observation:			
a. Weak or inoperative compression spring.	EA		
*** {Severity L}			
b. Damaged or inoperative manual operating mechanism.	EA		
*** {Severity L}			
c. Damaged or defective hinge system.	EA		
*** {Severity L}			
d. Damaged latch mechanism, still functioning.	EA		
*** {Severity M}			
e. Damaged or missing latch mechanism, inoperable.	EA		
*** {Severity H}			
f. Missing or inoperative fusible linkage, if used as smoke vent.	EA		
*** {Severity H}			

04.08 ROOF SPECIALTIES

COMPONENTS (Continued)

◆ 04.08.06 SNOW CLEATS

Snow cleats are installed on steep sloped roofs to prevent ice and snow from falling on pedestrian walkways.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Loose or defective snow cleat.			
Observation:			
a. Loose snow cleat.	EA		
*** {Severity M}			
b. Bent or missing snowcleat.	EA		
*** {Severity H}			

04.08 ROOF SPECIALTIES

COMPONENTS (Continued)

◆ 04.08.07 RUN-OFF DIVERTERS

Run-off diverters are installed on steep sloped roofs to direct water away from walkways when gutters are not utilized.

Defect:	UOM	LEVEL II KEY	LEVEL III KEY
* Protective coating defects.			
Observation:			
a. Surface protective coating missing (paint/galvanizing).	LF		
*** {Severity L}			
b. Corrosion evidenced by pitting or blistering.	LF		
*** {Severity M}			
c. Corrosion evidenced by holes or loss of base metal.	LF		
*** {Severity H}			
* Damaged or missing run-off diverter.			
Observation:			
a. Loose run-off diverters.	LF		
*** {Severity M}			
b. Damaged or missing run-off diverter.	LF		
*** {Severity H}			

04.08 ROOF SPECIALTIES

REFERENCES

1. Architectural Graphic Standards, AIA Seventh Edition, 1981
2. Building Design and Construction Handbook, 4TH Edition, Merritt, 1982
3. McMaster-Carr Supply Company, Catalog 99
4. Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

04.08 ROOF SPECIALTIES

LEVEL II KEY	GUIDE SHEET CONTROL NUMBER
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N/A

LEVEL III KEY	GUIDE SHEET CONTROL NUMBER
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N/A

APPENDIX A

ABBREVIATIONS

AIC	American Institute of Chemists
BUR	Built Up Roof
CAIS	Condition Assessment Information System
CAS	Condition Assessment Survey
CERL	Construction Engineering Research Laboratory
CPE	Chlorinated Polyethylene
CSPE	Chlorosulfonated Polyethylene (hypalon)
DCD	Data Collection Device
DIA	Diameter
EA	Each
EPDM	Ethylene Propylene Diene Monomer
FT	Foot
GS	Guide Sheet
HRS	Hours
I.E.	"That Is"
IU	Inspection Unit
LF	Linear Foot
N/A	Not Applicable
NAVFAC-MO	Naval Facilities Maintenance and Operations
NDT	Non-Destructive Testing
PE	Professional Engineer
PM	Preventive Maintenance

APPENDIX A

PIB	Poly-isobutylene
PUF	Poly-Urethane Foam
PVC	Polyvinyl Chloride
RPIL	Real Property Inventory List
SF	Square Foot
TM	Technical Manual
UOM	Unit Of Measurement
YRS	Years
WBS	Work Breakdown Structure
°	Degrees of Temperature
°C	Degrees Centigrade
°F	Degrees Farhenheit
=	Equals
'	Feet
>	Greater Than
≥	Greater Than or Equal To
"	Inches
<	Less Than
≤	Less Than or Equal To
/	Per or Over
%	Percent
+	Plus or Positive or Add
±	Plus or Minus
-	Subtract or Minus or Negative

APPENDIX A

• Times or By

x Times or By

APPENDIX B

GLOSSARY

Acrylic	One of a group of thermoplastics made from esters of acrylic acid; exceptionally tough, stable, resistant to chemicals, and transparent; used as a binder, in sheet form, as an air-curing adhesive, and as the main ingredient in some caulks and sealants.
Aggregate	Crushed stone, crushed slag, or water worn gravel, used for surfacing a built-up roof; designed to act as a ballast.
Alligatoring	The cracking of the surfacing bitumen on a built-up roof, producing a pattern of cracks similar to an alligator's hide; the cracks may or may not extend through the surfacing bitumen.
Asbestos	Fine, flexible, noncombustible, inorganic fiber obtained from natural hydrous magnesium silicate; can withstand high temperatures without change; a poor heat conductor; is fabricated into many forms either alone or with other ingredients. Has been found to cause cancer and other respiratory diseases.
Asphalt	A dark brown to black cementations material, solid or semisolid, in which the predominating constituents are bitumens which occur in nature. Used in built-up roofing systems as a waterproofing agent.
Ballast	An aggregate whose particle size depends on the type of roofing system being applied. It is applied to the surface of the roofing system to protect the roofing from wind and water. It provides protection from wind uplift, and capillary action to evaporate standing water.
Bitumen	A semisolid mixture of complex hydrocarbons derived from coal or petroleum, as coal-tar pitch or asphalt; before application, usually dissolved in a solvent, emulsified, or heated to a liquid state.
Bold Rib	A type of metal roofing panel with a deeper corrugation and a narrower rib than box rib.
Bowl	A deep rounded container, open at the top.
Box Rib	A type of corrugation using a squared, raised, ridge or fold which is formed in sheet metal to provide stiffness.

APPENDIX B

Built-up Roof Membrane	A continuous, semi-flexible roof membrane assembly, consisting of plies of saturated felts, fabrics, or mats between which alternate layers of bitumen are applied, generally surfaced with mineral aggregate, bituminous materials, or a granule-surfaced roofing sheet.
Butyl rubber	A synthetic rubber made by the polymerization of isoprene and isobutylene.
Capacitance meter	A device designed to locate trapped moisture in roofing systems. The device transmits low frequency signals through the roof covering. When these signals come in contact with a conductive layer in this case moisture, the circuit is complete and an audible and visual signal is transmitted to the operator.
Cement	A material or a mixture of materials (without aggregate) which, when in a plastic state, possesses adhesive and cohesive properties and hardens in place. Frequently, the term is used incorrectly for concrete, e.g. a "cement" block for concrete block.
Closure Strips	Used to seal the roofing panels to the structure; generally made of foam rubber, in the form of the corrugation pattern. The strips are placed atop a purlin or beam perpendicular to the longitudinal axis of the panel to fill in the corrugations at the eaves or edge of the structure; thus providing a weather tight seal.
Corrugated	Wrinkled, shaped, or contracted into parallel grooves and ridges. As in fluted or ribbed panels for decking.
Crazing	Fine, random cracks or fissures in a network on or under a surface of plaster, cement, mortar, concrete, ceramic coating, or paint film caused by shrinkage.
Crickets	A small saddle-shaped projection on a sloping roof; used to divert water around an obstacle such as a chimney.
Curbs	A low wall of wood, metal, or masonry built around an opening in a roof or placed on the surface of a roof to support equipment.
Deformation	Any change of form, shape, or dimensions produced in a body by a stress or force, without a breach of the continuity of its parts.

APPENDIX B

Delaminated	A failure in a laminated structure; characterized by the separation or loss of adhesion between plies, as in built-up roofing.
Downspout	A vertical pipe used to conduct water from a roof drain or gutter to the ground or sewer system. Also known as a rain leader, a downcomer, or conductor.
Drains	Any pipe in a building drainage system which carries waste water or waterborne waste.
Drip edge	A horizontal molding fixed atop the fascia board and under the first row of shingles or tiles. It carries the water away from the edge of the fascia board and into the gutter or onto the ground.
Eave	The lower edge of a sloping roof; that part of a roof of a building which projects beyond the wall.
Elastomeric	Said of any material having the properties of an elastomer. Which is a macromolecular material (such as rubber or a synthetic material having similar properties) that returns rapidly to approximately the initial dimensions and shape after substantial deformation by a weak stress and release of that stress.
Electrolysis	The decomposition of a chemical compound into its constituent elements by the passage of an electric current; this action leads to the decomposition of metals.
Expansion joint	A joint or gap between adjacent parts of a structure, or concrete work; which permits their relative movement due to temperature changes (or other conditions) without rupture or damage.
Flange	A projecting collar, edge, rib, rim, or ring on a pipe, shaft or the like. Also one of the principle longitudinal components of a beam or girder which resists tension or compression.
Flashing	The system used to seal roof membrane edges at walls, expansion joints, drains, gravel stops, and other places where the membrane is interrupted or terminated. A thin impervious material placed in construction (e.g. in mortar joints and through air spaces in masonry) to prevent water penetration and or provide water drainage, especially between a roof and wall, and over exterior door openings and windows.

APPENDIX B

Flashing Boot	The flange and metal casing around a pipe or other penetration that passes through a roof.
Flashing Cement	A mixture of bitumen, solvent, and inorganic reinforcing fibers, such as glass or asbestos fibers; applied with a trowel.
Fishmouths	A half-cylindrical or half-conical opening formed by an edge wrinkle. In shingles, a half-conical opening formed at a cut edge.
Fusible Links	A metal chain link made of a low-melting point alloy; in case of fire, the chain breaks, thereby closing a damper, door, or the like.
Gable Rake Tiles	Tiles that cover the outside edge of the rake (that being a board or molding along the sloping edge of a gable), covers the sloping edge of a roof.
Galvanizing	The process of coating steel or iron with zinc by immersing it in a bath of molten zinc.
Gutters	A shallow channel of metal or wood set immediately below and along the eaves of a building to catch and carry off rainwater from the roof.
Hip Caps	A hip is the external angle at the junction of two sloping roofs or sides of a roof. The hip cap is the tile or other protective covering over a hip.
Hypalon	An elastomeric roof covering in liquid, sheet or putty-like (caulking) consistency. Hypalon roofing is more resistant to thermal movement and weathering than Neoprene. Hypalon is a registered trademark.
Hydrostatic Pressure	The pressure equivalent to that exerted on a surface by a column of water of a given height.
Inorganic Felts	A flexible sheet manufactured by the interlocking of fibers through a combination of mechanical pressure, moisture and heat. Felts are manufactured principally from vegetable fibers (organic felts), asbestos fibers (asbestos felts), or glass fibers (fiberglass felts); these last two make up the majority of inorganic felts (inorganic: being or composed of matter other than hydrocarbons and their derivatives; or matter that is not of plant or animal origin).

APPENDIX B

Isotropic	Said of a material which has the same physical properties in all directions.
Lap	To overlap or partly cover one surface with another, as in shingling. The length of the overlap, as the distance one tile extends over another.
Leaders	A downspout for conducting water, or a duct for conducting hot air; an outlet in a hot air heating system.
Level	A horizontal line or plane; especially such a plane taken as a basis for the measure of elevation.
Life Cycle	Under normal conditions, the expected life span based on proper installation and preventive maintenance.
Mils	A unit of measure equal to a thousandth of an inch.
Misaligned	Not in a straight line, not in agreement, not parallel or on the same level.
Modified Bitumen	Composite sheets consisting of a copolymer added to bitumen, often reinforced and sometimes surfaced with various types of films, foils, and mats.
Neoprene	A synthetic rubber (polychloroprene) used in liquid-applied and sheet-applied elastomeric roof membranes or flashings.
Nuclear Moisture Meter	This device measures the amount of hydrogen present in the roof; hydrogen is a principal element in water. The device is designed to both detect and quantify the hydrogen atoms present in the roofing system.
Ogee	A double curve, formed by the union of a convex and concave line, resembling an "S" shape.
Organic Felts	A flexible sheet manufactured by the interlocking of fibers through a combination of mechanical work, moisture and heat. Felts are manufactured principally from vegetable fibers (organic felts) asbestos fibers (asbestos felts) or glass fibers (glass fiber felts).
Pipe Sleeves	A cylindrical insert, placed in a form for a concrete wall or deck, in a location where a pipe is to penetrate the structure; the insert prevents concrete from flowing into the cylindrical opening before it hardens.

APPENDIX B

Pitch Pockets (pans)	A metal flange around the base of any roof penetrating member or component which is filled with pitch or flashing cement to provide a seal.
Plumb	Exactly Vertical.
Ponding	An accumulation of water on a flat roof because of clogged or inadequate drains.
Purlin	A piece of timber or metal laid horizontally on the principle rafters of a roof to support the common rafters on which the roof covering is laid.
Reglet	A groove in a wall or other surface, adjoining a roof surface for use in the attachment of counterflashing.
Roof Pitch	The slope of a roof, usually expressed as a ratio of vertical rise to horizontal run, or in inches of rise per foot of run.
Saddles	A small structure that helps channel surface water to drains, frequently located in a valley, and often constructed like a small hip roof or like a pyramid with a diamond shape base.
Scuppers	An opening in a wall or parapet that allows water to drain from a roof. Also a device placed in such an opening to prevent clogging of the drain.
Scuttle	A hatch that provides access to the roof from the interior of the building.
Shakes	Any thick hand-split shingle or clapboard, usually edge-grained; formed by splitting a short log into tapered radial sections.
Shingle	A small unit of prepared roofing material designed for installation with similar units in overlapping rows on inclines normally exceeding twenty-five percent.
Shingle Ridge Flashing	The same shingles used on the flats of the roof are used to cover the area where two slopes meet. Done by cutting the shingle tabs apart and laying them perpendicular to the longitudinal axis of the ridge.
Shingle Tabs	That lower part of a shingle which is exposed to the weather and lays on top of the course below.

APPENDIX B

Silicone	One of the family of polymeric materials in which the recurring chemical group contains silicon and oxygen atoms as links in the main chain; derived from silica and methyl chloride; characterized by resistance to heat and a low coefficient of thermal expansion.
Slope	Any inclined line, surface, position, etc. (slant) Deviation from the horizontal or vertical.
Snow Cleat	A device intended to prevent snow from sliding off the roof; also called snow guards.
Splash Blocks	A small masonry block laid on the ground below a downspout to carry roof drainage away from a building and to prevent soil erosion.
Sprayed-on Foam	A plastic expanded chemically, mechanically, or thermally, to form a lightweight closed-cell structure; used as thermal insulation.
Standing Seam	In metal roofing, a type of seam between adjacent sheets of material, made by turning up the edges of two adjacent sheets and then folding them over.
Strainer	A device for withholding foreign matter from a flowing liquid or gas; a sieve.
Terne Coated Stainless Steel	Sheet steel which is coated with "terne metal" (an alloy of lead, containing up to 20% tin) widely used for roofing and construction work.
Urethane	A solid or spongy cellular material produced by the reaction of a polyester (such as glycerin) with a diisocyanate (such as toluene diisocyanate), carbon dioxide is liberated by the reaction of a carboxyl with the isocyanate; used for thermal insulation, soundproofing, and padding.
Valley	The trough or gutter formed by the intersection of two inclined planes of a roof.
Valley Flashing	The sheet metal used to line the valley on a roof.

APPENDIX C

LIFE CYCLES**04 ROOFING****04.01 BUILT-UP MEMBRANE ROOFING**

3 Ply	15 Years
4 Ply	20 Years
5 Ply	25 Years

Source:

TM 5-617/MO-113/AFM 91-31/MCO P11014.9, Maintenance and Repair of Roofs

04.02 SINGLE-PLY MEMBRANE ROOFING

Single-Ply Membrane Roofing	20 Years
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Source

Allied Building Products Corp., Chesapeake, VA

04.03 PANEL ROOFING

Panel Roofing	35 Years
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Source:

TM 5-617/MO-113/AFM 91-31/MCO P11014.9, Maintenance and Repair of Roofs

04.04 ASPHALT ROLL ROOFING

Asphalt Roll Roofing	15 Years
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Source:

TM 5-617/MO-113/AFM 91-31/MCO P11014.9, Maintenance and Repair of Roofs

04.05 SHINGLE ROOFING

Asphalt shingles	20 Years
Wood shakes and shingles	30 Years
Asbestos shingles	50 Years
Slate shingles	100 Years

Sources:

Means Facilities Maintenance Standards, Roger W. Liska, PE, AIC, 1988

TM 5-617/MO-113/AFM 91-31/MCOP11014.9, Maintenance and Repair of Roofs

APPENDIX C

04.06 TILE ROOFING

Tile Roofing 50 Years

Source:

TM 5-617/MO-113/AFM 91-34/MCO P11014.9, Maintenance and Repair of Roofs

04.07 FLUID APPLIED MEMBRANE ROOFING

Fluid Applied Membrane Roofing 20 Years

Source:

TM 5-617/MO-113/AFM 91-34/MCO P11014.9, Maintenance and Repair of Roofs

04.08 ROOF SPECIALTIES

Roof Hatch, Painted Steel	24 Years
Roof Hatch, Galvanized	40 Years
Roof Hatch, Stainless	40 Years
Roof Vents	40 Years
Skylights, Single & Double Glazed	40 Years
Snow Cleat	20 Years
Run-Off Diverters	20 Years

Source:

Means Facility Maintenance Standards, Roger W. Liska, PE, AIC, 1988